Assessing the effectiveness of a climate change communication intervention:

An experimental study

Thesis

Presented in Partial Fulfillment of the Requirements for

the Honors Degree of Bachelor of Science in the

School of Environment and Natural Resources

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The Ohio State University

Summer 2015

Acknowledgements

I would like to thank my advisor, Dr. Robyn Wilson, for all of the patience, encouragement and advice she provided throughout the research process to produce this paper. I am also very grateful to the students and faculty at SENR and employees of Columbus Public Health who developed the surveys and community presentation for this project, as well as those who helped as presenters, including: Eugene Beers, Kristina Bomberger, John Crawford, Ellen Eilers, Rick Hicks, Emily Hutchins, Ajay Singh, and Kristina Slagle, among others.

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Major Field: Environment, Economy, Development, and Sustainability

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Chapter 1. Introduction

As regions across the world experience conditions such as variability in precipitation and higher frequency of erratic weather events, the discussion surrounding climate change has gained momentum and expanded globally. Governments on the local and national level are making a concerted effort to develop action plans and policy frameworks to support climate mitigation and adaptation strategies in the face of increasing variable climate patterns and extreme weather events. As a result, these efforts must be accompanied by effective communication pieces [particularly tailored to the topic of climate change, since this information is complex and unfamiliar to the public, especially the uncertain risks associated with it (Pidgeon and Fischoff, 2011).

In the United States, research on public perception of global climate change demonstrates that the general American public has a high awareness and concern for the issue, but its salience in the political arena is low (Brody et al., 2008; Leiserowitz, 2006). This relationship between high support and relatively low political action in favor of climate policy has concerned researchers about the effectiveness of communication and education surrounding the issue and has led to a growing body of research on the topic of climate change communication. The general consensus among researchers is that several key beliefs regarding the causes and consequences of climate change are essential components of effective communication strategies to influence public perception and predict change in behavior (Kellstedt et al, 2008; Roser-Renouf et al., 2014; Sterman, 2008). According to a recent study on American's perceptions of climate change, only about 22% of the population estimate that there is scientific consensus on whether climate change is happening (Leiserowitz et. al, 2014). This misconception is detrimental to the public's understanding of climate change, as some researchers have identified

agreement on scientific consensus to be a gateway belief to influencing the public's engagement with climate mitigation efforts (Ding et. al, 2011; van der Linden et. al, 2015). Kahan, Jenkins-Smith, & Braman (2011) further analyzed the influence of cultural cognition, or tendency of individuals to conform their beliefs of facts to their cultural values, as an explanation for the failure of individuals to form beliefs that align to the scientific consensus on climate change. Their findings demonstrated a strong correlation between cultural values and perceptions of scientific consensus, which supports the notion that individuals selectively recognize information that reinforces their cultural predispositions (Kahan, Jenkins-Smith, & Braman, 2011).

Taking this into consideration, the incorporation of culturally-specific characteristics in communication efforts are viewed as imperative to better engage and inform audiences on climate change (Kahan et. al, 2012; Kahan, Jenkins-Smith, & Braman, 2011; Weber and Stern, 2011). This means that communicators should include information in their interventions that is relevant to the important values of the audience. For example, an audience that is mostly comprised of low-income individuals might demonstrate more interest in the climate change presentation if the information relates to how the issue will jeopardize financial security or how the impacts of climate change can harm disadvantaged populations the most.

When trying to increase public understanding, scientists must be cautious of how they explain the processes that inform climate change since it is such an unfamiliar subject relying on unfamiliar tools, such as simulation modeling, to generate projections (Pidgeon and Fischoff, 2011). Poor understanding of stock and flow, as well as feedback of the climate system can lead individuals to over- or underestimate the uncertain causes and implications of extreme weather events (McBean & Hengeveld (2000); McCaffrey and Buhr, 2008; Pidgeon and Fischoff, 2011; Sterman, 2008). Additionally, accurate knowledge of what causes climate change was the

strongest predictor of behavioral intention for individuals to voluntarily take action and vote on hypothetical referenda to establish new greenhouse gas reduction policies (Bord et al., 2000)

According to a recent study on American's perceptions of climate change, only about 22% of the population estimate that there is scientific consensus on whether climate change is happening (Leiserowitz et. al, 2014). This misconception is detrimental to the public's understanding of climate change, as some researchers have identified agreement on scientific consensus to be a gateway belief to influencing the public's engagement with climate mitigation efforts (Ding et. al, 2011; van der Linden et. al, 2015). Kahan, Jenkins-Smith, & Braman (2011) further analyzed the influence of cultural cognition, or tendency of individuals to conform their beliefs of facts to their cultural values, as an explanation for the failure of individuals to form beliefs that align to the scientific consensus on climate change. Their findings demonstrated a strong correlation between cultural values and perceptions of scientific consensus, which supports the notion that individuals selectively recognize information that reinforces their cultural predispositions (Kahan, Jenkins-Smith, & Braman, 2011). Taking this into consideration, the incorporation of culturally-specific characteristics in communication efforts are viewed as imperative to better engage and inform audiences on climate change (Kahan et. al, 2012; Kahan, Jenkins-Smith, & Braman, 2011; Weber and Stern, 2011). This means that communicators should include information in their interventions that is relevant to the important values of the audience. For example, an audience that is mostly comprised of low-income individuals might demonstrate more interest in the climate change presentation if the information relates to how the issue will jeopardize financial security or how the impacts of climate change can harm disadvantaged populations the most.

Even so, researchers would also argue that an individual doesn't need to be highly literate in science to demonstrate concern for climate change (Kahan et. al, 2012; Leshner, 2003; Leiserowitz, 2006; Weber and Stern, 2011). In a recent study, Kahan et al. found that participants who demonstrated the highest scores in scientific literacy were not the most concerned about climate change (2012). Thus, instead of concentrating efforts on altering understanding of the issue, alternative strategies put emphasis on understanding the role of risk perceptions (Leiserowitz, 2006; Leshner, 2006) and cultural values and beliefs (Weber and Stern, 2011) on influencing people's climate change perceptions and actions.

In this thesis, I first explore past research in public understanding of climate science, the factors influencing this understanding, public engagement with climate mitigation, and communication strategies. Based on the literature, there are several factors that influence perception of climate change and key attributes of effective science communication that could lead to behavioral shifts, particularly activism in the policy arena. In particular, prior research suggests that there are four key beliefs associated with support for climate action (climate change is real, human-caused, dangerous - interpreted as risk perception, and solvable - interpreted as efficacy). The objective of my research was to test the effect of a communication effort targeting these beliefs on public attitudes, beliefs, and behaviors (namely, support for policy).

Chapter 2. Literature Review

2.1 Climate Change Communication

Much of the literature on climate change communication highlights four key beliefs as underlying factors in predicting the level of concern and action individuals will take to address climate change (Ding et al., 2011; Krosnick et al., 2006: Roser-Renouf et al., 2014; van Der Linden et al., 2015). These beliefs include: climate change is real, it is caused by humans, it is dangerous, and it is solvable. The belief that climate change is dangerous is primarily measured by risk perception and affect, while the belief that climate change is solvable is measured by individual and collective efficacy. Agreement on these beliefs is predicted to have a relationship with perception of scientific consensus (Ding et al., 2011; van Der Linden et al, 2015), increased level of concern for public action (Krosnick et al., 2006; van Der Linden et al., 2015), and increased level of policy support and climate activism (Ding et al., 2011; Roser-Renough et al., 2014).

According to Leiserowitz et al. (2014), only about 63% of Americans believe climate change is happening and 47% believe that it is human caused. Such moderate levels are a concern because existence beliefs of climate change can impact how individuals interpret the seriousness of climate change and therefore, how it is prioritized in the political arena (Krosnick et al., 2006). Moreover, the certainty with which these beliefs are held is essential in predicting the degree of issue involvement that individuals will have. Myers et al (2013) posits that an individual's certainty of the existence of climate change is a function of both experiential learning and motivated reasoning. Their research found that experiential learning, where personal experience influences belief certainty, mostly occurred in individuals who were less engaged in climate change. On the other hand, motivated reasoning, where belief certainty

influences perceptions of personal experience, was found to occur mostly in individuals who were already highly engaged in the issue (Myers et al., 2013). The ability to recognize and address characteristics that affect key climate beliefs such as these can help communicators improve their overall intervention strategy and inform message design. The following sub-sections will discuss additional factors that influence agreement with the four key climate beliefs and public engagement with climate change.

2.1.2 Knowledge

In general, the complex nature of the climate system, the nonlinearity and uncertainty of climate science projections, and the diverse policies and technologies needed to address climate change make the issue an inherently difficult one to understand (McCaffrey and Buhr, 2008; Pidgeon and Fischoff, 2011; Weber, 2010; Weber and Stern, 2011). The uncertainty that climate projections yield can be challenging for scientists to explain and for lay people to comprehend and translate into action (Pidgeon and Fischoff; Weber, 2010). Particularly in the political arena, uncertainties in climate science limit the accuracy of risk assessments and complicate the policy decision-making process for mitigation and adaptation efforts (Weber, 2010). However, uncertainty can also serve as an advantage for science communicators. Rabinovich and Morton (2012) found that communicating a message with high uncertainty was more persuasive amongst individuals who considered science a debate, as opposed to it being the absolute truth leaving little room for ambiguity. These results inform the perspective that lack of understanding is not a limiting factor to taking action against climate change (Weber and Stern, 2011), but instead the style of the scientific message (Kahan et. al, 2012; Kahan, Jenkins-Smith, & Braman, 2011; Rabinovich and Morton).

As witnessed in our brief review of public understanding, the lack of public understanding still causes researchers to question the impact of knowledge on public attitudes and climate mitigation actions. Deficits in knowledge are commonly considered to help explain disparities in climate mitigation action according to the knowledge deficit model (Sturgis and Allum, 2004; Kellstedt, Zahran, and Vedlitz, 2008). The knowledge deficit model posits that individuals are willing and able to process information if it is available, and thus simply more education is needed to influence public engagement (Gross, 1994). While some researchers agree that the knowledge deficit model helps explain the integral role of knowledge in forming public attitudes (Sturgis and Allum, 2004), other researchers have found that informedness doesn't always translate to a concern for global warming (Kellstedt, Zahran, & Vedlitz (2008) and suggest that lack of public understanding can be a result of a deficit in trust in scientists (Malka, Krosnick, & Langer (2009). Taking these studies into consideration, it is evident that knowledge and understanding of climate change are important foundational factors to lead to public engagement with climate mitigation efforts, but they are not the only contributing factors. Much emphasis has been put on assessing the public's understanding of climate change, and yet some researchers still feel that there is a need to provide better mental models of the public's misconceptions and their risks regarding climate change (Weber and Stern, 2011).

2.1.2 Perceived Risk

Risk perception has consistently been identified as a highly influential factor in raising concern and action to address climate change (Bord et al., 2000; Leiserowitz, 2006; Roser-Renough et al., 2014; Slimak and Dietz, 2006). By informing people of the risks of climate change, it is expected that a sense of urgency will spur action to limit its consequences. In

determining the appropriate level of concern to attribute to climate change, a gap exists between climate professionals and the general public. Slimak and Dietz (2006) discovered through a mental model that scientists are most concerned about long-term ecological risks of climate change, while the lay public are mostly concerned about catastrophic events that are highly risky, but have low probability of occurring. Furthermore, Americans generally perceive climate change as a moderate risk, but one that will mostly affect geographically distant places, future generations, or other species (Leiserowitz, 2006; Leiserowitz et al., 2014). These findings ultimately demonstrate that the American public feels psychologically distant from climate change (Krosnick et al., 2006), which can limit its saliency as a political issue (Leiserowitz, 2006).

As a result, researchers stress establishing climate change as a personally relevant risk in order to gain policy support for mitigation and adaptation efforts (Kahan et al., 2012; Leiserowitz, 2006; Lorenzoni and Pidgeon, 2006; Weber, 2006). Localizing the content of intervention efforts by providing closer spatial and temporal scientific predictions of future events (Weber, 2006) and incorporating cultural elements specific to communities (Kahan et al., 2012) are both proposed improvements that can be made to climate change communication efforts.

2.1.3 Values

Experiential factors such as values, imagery, and affect, which denotes a person's negative or positive feelings towards things, can contribute to shaping risk perception and key climate beliefs as well (Leiserowitz, 2006). The value commitments that individuals hold often inform the perspectives they have regarding concern for global warming. Particularly, people

who hold strong ecological (Kellstedt et al., 2008) or altruistic values (Slimak and Dietz, 2006) are likely to be more concerned about global warming and have a higher perception of risk, than those who do not share these values. Also, an individual's worldview can be a significant predictor of pro-environmental behavior and support for climate policy. O'Connor et al. (2002) found that people who hold an ego-environmentalism worldview are more likely to support mitigation efforts as long as they are not perceived to threaten their jobs, limit their personal freedoms, or hurt the economy. Their research identified risk perception and knowledge as being most influential for individuals to support reduction of greenhouse emissions, especially for those holding the ego-environmentalism worldview (O'Connor et al., 2002). Additionally, to better communicate with different audiences holding specific cultural values, researchers recommend that science communicators embed cultural meaning into the content of their scientific information (Kahan, Jenkins-Smith, & Braman, 2011; Weber and Stern, 2011).

Moreover, political ideology can also be considered as reflective of a set of values that influence support and action for climate change mitigation and adaptation. The differences of concern and action towards climate change related to partisan affiliation vary. Some studies show conservatives and Republicans as having more concern for global warming (Kellstedt, Zahran, and Vedlitz, 2008), while other studies find that Democrats are more likely to support government greenhouse gas reduction initiatives (O'Connor et al., 2002). Somewhat of a middle ground has been discovered that shows strong bipartisan support for actions to address climate change, but overall these policy preferences were more so related to an individual's value commitments than political ideology (Leiserowitz, 2006).

2.1.4 Efficacy of Action

The belief that individuals or collectives can effectively take action to address the issue of climate change is an influential factor for gaining public support and engagement (Finkel et al., 1989; Kellstedt et al., 2008; Weber, 2010). The literature suggests that people are more likely to have higher belief in collective efficacy, than individual efficacy (Leiserowitz et al, 2013; Lorenzoni and Pidgeon, 2006; Roser-Renough et al., 2014). That is, they can successfully address the problem as a group, more so than as an individual. A survey of Columbus, Ohio residents found that virtually all residents believed collective action could contribute to reducing global warming, but they also demonstrated a lack of confidence in the feasibility of rallying everyone together to carry out the necessary actions (Leiserowitz et al., 2013). This finding is consistent with an earlier model, the personal influence model, proposed by Finkel et al. in 1989. The personal influence model posits that personal influence on provision of a public good and the likelihood of group success can determine involvement in collective political action (Finkel et al., 1989). Finkel et al. ultimately found that individuals were more likely to contribute to collective action when perceptions of individual influence and likelihood of group success were high (1989).

Additionally, reassuring individuals that there is a possible solution to reducing climate change's consequences can counterbalance their heightened risk perception of these consequences (Lorenzoni and Pidgeon, 2006; Roser-Renough et al, 2014). This component has been considered essential to effective science communication interventions. Additionally, Weber (2010) believes that concern about the existence of climate change does not need to precede the search for successful solutions in order to gain public support for climate policies. Focusing on the issue's solvability and providing solutions can even prompt skeptics to acknowledge that the problem exists (Weber 2010).

2.1.5 Personal Experience

With climate change considered a psychologically distant risk, accounts of personal experience can be especially important in informing beliefs, concerns, and actions towards climate change (Krosnick et al., 2006; Myers et al., 2013; Weber, 2006). About 51% of Columbus, Ohio residents demonstrated psychological distance from the issue by stating they hadn't personally experienced its consequences (Leiserowitz et al., 2013). Research shows that if people feel they have personally witnessed suspected consequences of climate change, such as rising temperatures, then they are more likely to believe in the existence of the issue (Krosnick et al., 2006). Moreover, this interaction between personal experience and prior beliefs is significant. Personal experience with climate change can serve two functions of either influencing a person to take on the belief that climate change is real, by way of motivated-reasoning, or strengthen an existing belief that climate change is real (Myers, et al., 2013). However, coming to this conclusion via personal experience of climate change's devastating consequences may be too late for taking corrective action (Weber, 2006).

2.1.6 Responsibility

Leiserowitz (2006) described the American public as being in a stage where they hope the climate change issue can be solved by someone else, but without actual changes being made to their own lifestyles. A key determinant of whether an individual will address climate change is their own sense of responsibility for the issue and their perception of control (Lorenzoni and Pidgeon, 2006). Particularly, in Columbus, Ohio, the majority of residents hold corporations and industries accountable for addressing climate change (Leiserowitz et al., 2013). A different study

by Kleim (2008) found that individuals held public authorities and institutions responsible for supporting localized adaptation efforts and establishing an appropriate political atmosphere for climate policies. In both cases, the responsibility to address climate change was reassigned to larger entities. This may be due to people thinking that one individual is not able to dramatically alter the climate, like a larger and collective entity can. Thus, if a single person isn't responsible then a single person shouldn't bear the responsibility for addressing the consequences. Additionally, responsibility to address climate change is often low for well-informed individuals (Kellstedt et al., 2008), which may be because they feel detached from a problem that they know little about. Even more interesting, Kellstedt et al (2008) found that responsibility to address climate change is higher amongst older individuals, which could possibly be due to a subconscious acceptance of responsibility for the damages towards the planet and thus feeling responsible to correct those mistakes.

2.1.7 Trust

Climate scientists and communicators have a difficult, but necessary task of establishing credibility with the public such that they can effectively raise awareness and encourage public engagement. Building up the public's trust in government and institutions can be influential in raising collective efficacy and reassuring the feasibility of addressing climate change (Lorenzoni and Pidgeon, 2006). This way, individuals will be more willing to support climate mitigation and adaptation initiatives if they know they have the resources to be successful. On the other hand, a study by Kellstedt et al. found that high confidence in scientists can yield opposite reactions towards addressing climate change (2008). For example, individuals who are highly confident in scientists were found to have low concern and low sense of responsibility for global warming,

which may be due to their trust that scientists will create future technical solutions (Kellstedt et al, 2008). Either way, scientists and communicators must be cautious of how they communicate climate science because the small, but powerful voice of climate skeptics can further complicate the process of securing public trust (Schmidt, 2010).

2.1.8 Message Framing

In framing the issue of climate change, many researchers have taken varying viewpoints on what types of frames are most effective to influence beliefs, perceptions, and actions towards addressing climate change. Essentially, a frame is used to refocus the audience's attention on a particular aspect of an issue, such as to encourage a certain interpretation and discourage others (Nisbet, 2009). Despite differences in types of frames used, common agreement amongst researchers is that the communication frame should be aligned with the overall goal of the intervention and specifically relevant to the interests of the targeted audience (Nisbet, 2009; Weber, 2010; Weber and Stern, 2011). Nisbet (2009) supports the notion of using different types of framing, specific to each audience, as tools to create a common ground that brings an audience together and shapes their behavior to mobilize them for collective action. For example, to increase public understanding of climate change risks, Weber & Stern (2011) recommend using a simple conceptual frame that is congruent with the audience's level of knowledge, yet focuses on altering which climate events are perceived as having more risk. Thus, the communicator does not try to alter what the audience member identifies as a risk, but instead focuses on influencing the level of perceived risk the individual associates with each climate event.

The uncertainty of climate science can also serve as an advantage for science communicators as a frame. Rabinovich and Morton (2012) found that communicating a message

with high uncertainty was more persuasive amongst individuals who considered science a debate, as opposed to it being the absolute truth leaving little room for ambiguity. These results inform the perspective that lack of understanding is not a limiting factor to taking action against climate change (Weber and Stern, 2011), but instead the style of the scientific message (Kahan et. al, 2012; Kahan, Jenkins-Smith, & Braman, 2011; Rabinovich and Morton).

On the other hand, framing can also be used to simplify the policy-decision-making process. Some communicators in the political sector have successfully refocused their arguments on to the consequences of inaction to reduce emissions (Weber, 2010). By taking attention away from specific details about the precision of consequences of climate change, and instead focusing on what might happen in the absence of action to address climate change, this frame allows uncertainties to not be seen as obstacles to establishing climate policies. Additionally, frames that emphasize climate change as a public health issue significantly influence policy support for adaptation efforts, increase personal relevance, and enhance understanding of climate change (Kleim, 2008; Maibach et al., 2010). Moreover, Kleim (2008) found that individuals respond better to information about the health benefits of climate change mitigation policies, as opposed to health risks associated with the issue. In fact, the communication treatment used in this thesis project used a public health frame to inform and engage Columbus, Ohio residents in climate change.

2.1.9 Proposed Strategies

Taking all of these factors into consideration, researchers suggest numerous improvements to enhance the effectiveness of future climate change communication efforts. First

and foremost, experts recommend that intervention messages should go beyond the simple transmission of scientific information (Kahan et al., 2012) and evolve into a bi-directional dialogue between communicators and the audience to allow for greater engagement with the issue (Leshner, 2003; Weber and Stern, 2011). Since the climate change debate features diverse perspectives, it is imperative for communicators to respect and try to understand the viewpoints of the audience as a means to working towards aligning key beliefs about climate change (Kahan et al., 2012). Additionally, incorporating cultural elements into the content of an intervention message can further increase the personal relevance of climate change to the audience and possibly increase the likelihood of individuals to engage or support climate mitigation efforts and policies (Kahan et al., 2012; Kahan, Jenkins-Smith, & Braman, 2011). For instance, a cultural element related to an audience of young college students at a climate change presentation might include special emphasis on the delayed consequences of the issue that will affect the future, such as sea-level rise, because these individuals are the most likely to experience future impacts. This culturally specific intervention strategy therefore reinforces experts' recommendation to localize intervention efforts so as to make the consequences and solutions to climate change appear tangible and attainable to people (Lorenzoni and Pidgeon, 2006). Ultimately, the use of a simplified, "one-size fits all" message design for an intervention is discouraged by researchers (Kahan, Jenkins-Smith, & Braman, 2011; Leiserowitz, 2006; Nisbet, 2009; Rabinovich & Morton, 2012).

When communicating the uncertainties of climate change, numerous researchers emphasize the importance of understanding the pre-existing beliefs held by members of the audience (Kahan et al., 2012; Kahan, Jenkins-Smith, & Braman, 2011; Rabinovich & Morton, 2012; Weber and Stern, 2011). In this way, communicators are more knowledgeable of how the

audience interprets science and thus they can better tailor a communication treatment. Additionally, as a supplement to understanding beliefs, other experts suggest that shaping the public's understanding of what science is and how uncertainty relates to it can increase their confidence in scientists and communicators (Rabinovich & Morton, 2012; Weber, 2006). Particularly with individuals who hold strong values, a direct approach to addressing fundamental misconceptions should be used that also resonate with cultural aspects, meaning concepts that are most important to a person's way of life, to gain a greater understanding (Leiserowitz, 2006). As people become more knowledgeable of climate science and familiar with mitigation and adaptation policies, some researchers suggest that the gap between scientists and public concern will eventually erode (Weber, 2010). Weber (2006) advocates for improved environmental science and statistics education to enhance the ability of the public to understand the presentation of scientific information. Lastly, a collaborative effort involving experts from an array of disciplines, ranging from subject-matter experts to program designers, is necessary to create a comprehensive intervention message that effectively informs, engages, and catalyzes individuals to address climate change (Pidgeon and Fischoff, 2011).

2.2.10 Research Study Objective and Hypotheses

The goal of this study was to test the effect of a communication effort targeting four critical beliefs (i.e., climate change is real, human-caused, dangerous - interpreted as risk perception, and solvable - interpreted as efficacy) on public risk perception, individual and collective efficacy, and support for climate mitigation policy. My research questions are the following:

1. Do participants receiving a climate change communication treatment yield a higher perception of risk toward climate change than individuals in a non-participatory control group?
2. Do participants receiving a climate change communication treatment yield higher levels of individual and collective efficacy to address climate change than individuals in a non-participatory control group?
3. Do participants receiving a climate change communication treatment yield a higher likelihood to support climate mitigation policy than individuals in a non-participatory control group?

I specifically propose the following hypotheses:

1. As a result of the communication treatment, participants receiving a climate change communication treatment will yield a higher perception of risk than individuals in a non-participatory control group.
2. As a result of the communication treatment, participants receiving a climate change communication treatment will have higher individual and collective efficacy than individuals in a non-participatory control group.
3. As a result of the communication treatment, participants receiving a climate change communication treatment will have a higher likelihood to support climate mitigation policy than individuals in a non-participatory control group.

Chapter 3. METHODS

This study is a microcosm of a larger project conducted by the Columbus Public Health Department (CPH) and the Environmental Social Sustainability Lab (ESS) at The Ohio State University to help the City of Columbus and CPH gauge the level of climate change awareness among Columbus residents through a climate change communication intervention. Using an experimental design, we also assessed the effectiveness of the communication intervention, a climate change PowerPoint presentation, in raising awareness about climate change. In this thesis, I focus on the latter by assessing the effectiveness of the climate change presentation to change an individual's perception of local and distant risks, individual and collective efficacy, and support of climate policy.

3.1 Intervention

The communication intervention or experimental treatment is a climate change PowerPoint presentation that uses interactive polling technology to benchmark current knowledge and then provides strategically framed information to address misconceptions and establish basic understanding of climate science, consequences, mitigation, and adaptation. The actual presentation can be found in Appendix A. Overall, the presentation is designed to emphasize four key beliefs, which climate change communication literature identifies as predictors of individual's engagement in climate activism (Roser-Renough et al., 2014). These beliefs include:

- Climate change is real; (i.e. Global temperatures today are less stable)
- Climate change is human-caused; (i.e. Burning of fossil fuels produces carbon dioxide)
- Climate change is dangerous; (i.e. Climate change is bad for Ohio; extreme weather)
- Climate change is solvable (i.e. Columbus Get Green initiative; bike sharing network)

Additionally, the agents delivering the presentation are members of the scientific and academic community at The Ohio State University. Due to time restrictions, I did not control for bias attributed to the difference in presenters in my analyses. This should be considered when analyzing my results.

3.2 Research Design

The study design is a mixed methodology approach to gauge the relationship between an individual's values, knowledge, beliefs, and their motivation to engage in behaviors that promote climate change activism. Using an experimental and a survey research design, we will measure if communication events, in this case presentations on climate change science and action, influence a change in beliefs, self-reported knowledge, and an individual's motivation to address climate change. Data will be derived from three sources: a pre-test distributed before the climate presentation (reference Appendix C), a post-test distributed after the climate presentation (reference Appendix C), and a separate online survey distributed to randomly selected Columbus residents (reference Appendix B). The online survey serves as our baseline or control group to assess the impact of the climate change presentation, since these participants did not receive information from the presentation.

3.2.1 Experimental Design

We used a pre-and post-test design to measure the effect of the PowerPoint presentations on an individual's climate beliefs, self-reported knowledge, and motivation to engage in or support climate adaptation measures.

Pre-test. Individuals were given a set of questions asking them about their beliefs about climate change, self-reported knowledge, who they attribute responsibility to for greenhouse gas

emissions, severity of consequences of climate change, social and personal norms that influence adoption of climate adaptation behaviors, and environmental values.

Post-test. After the presentation, individuals were given a set of questions asking them about their beliefs about climate change, self-reported knowledge, who they attribute responsibility to for greenhouse gas emissions, their perception of health and hazard related risk, their intention to engage in climate adaptation behaviors, and their support of policies and programs that the City of Columbus and CPH are considering for inclusion in future city and county plans. Additionally, participants were asked socio-demographic questions which include gender, age, sex, education level, household income, and political orientation.

3.2.2 Survey Design

Control. The study also uses a control group from a different sample population who received a full-length questionnaire, which includes questions that were asked in the pre and post-test survey via an online survey. These participants did not receive the climate change presentation.

Additional questions in this online survey covered health-related and hazard related risk perception, individual and collective efficacy, policy support, behavioral intentions, and attitudes toward action. Additionally, participants were asked socio-demographic questions which include gender, age, sex, education level, household income, and political orientation.

3.3 Sample Population and Survey Administration

This study involves two different sample populations. One sample population consists of members of the general public residing in Columbus who attended the climate change presentation. The presentations were given to residents of the Columbus metropolitan area who participate in or attend civic, business, or religious organization meetings. The sampling frame

was developed using the internet to compile a list of all Columbus area zip codes and then randomly selecting 16 zip codes. We then composed a list of civic, religious and business associations within those zip codes and contacted those associations via phone or email[1]. A total of 138 organizations were contacted and 19 presentations were scheduled, a response rate of 13.9%. Overall, only 16 presentations were conducted, representing 12 of the 16 zip codes. An optional pre- and post-test survey was distributed before and after the climate change presentation, respectively, and yielded 244 completed surveys.

The second sample population consisted of members of the general public residing in Columbus who did not attend the climate change presentation. They serve as a baseline or control group for the study. Members of this population completed a survey distributed through an online survey panel. To ensure a minimum number of completed surveys (n=400), we purchased a panel of respondents for $4,400 through Qualtrics. The survey was sent out to these respondents via e-mail January 31, 2014 through February 10, 2014 and yielded 420 responses, which were at least 70% completed. Due to incompleteness of the survey, we had to drop 14 respondents and were left with data from 406 respondents to use in the analyses.

3.4 Conducting Experimental Tests

To measure the impact of the climate change presentation on key climate beliefs, self-reported knowledge, and motivation to address climate change, we conducted three experimental design comparisons. The independent variable for all of the comparisons is the climate change

[1]We contacted each organization on our list by phone a maximum of three times before considering them a non-response. Messages were left if voicemail was available.

presentation because the study specifically focuses on the effect of the communication effort. The dependent variables differ for each of the three comparisons because of the variation in study design.

Since the study uses two different sample populations without random assignment for the control versus treatment groups, we first had to measure the variance between the participants of the climate presentation and the non-participants. Using a between groups design, we conducted an independent samples t-test to compare data from the pre-test experimental survey and the online survey. The questions from the pre-test and online survey were identical, which enabled direct comparison of responses. The dependent variables of interest included environmental values, issue relevance, personal relevance of climate change, self-reported knowledge, responsibility, climate beliefs, and belief efficacy.

A second comparison was conducted to assess climate presentation participants' changes in self-reported knowledge from Time 1, before the presentation, to Time 2, after the presentation. To do so, we used a within group repeated measures design and conducted a paired samples t-test between the pre-test and post-test data. The dependent variable of interest was self-reported knowledge.

The third, and most central, comparison of this study measures the influence of the climate presentation by comparing the post-test responses of individuals who received the presentation and the matching responses from individuals who did not receive the presentation (i.e., the baseline survey group). Using a between groups design, we conducted a multivariate analysis of covariance to compare data from the post-test and the online survey, as well as control for variables that were found to be statistically significant in the pre-test and online survey independent samples t-test. In this case, the post-test data represents the experimental

group and the online survey data represents the control group. The dependent variables of interest include self-reported knowledge, local risk perception, distant risk perception, individual efficacy, collective efficacy, policy support, affect and responsibility. The three covariates were environmental values, issue relevance, and belief efficacy.

3.5 Measures

All questions in the pre-test and post-test (reference Appendix C), and online surveys (reference Appendix B) were not identical so the following variables represent only those with questions that were identical in their respective survey in order to establish causal relationships.

Self-Reported Knowledge (pre-post). Knowledge was measured by self-reported data; respondents were asked to rate how well informed they were about climate change on a scale of 1 (not at all informed) to 5 (very informed) (Table 1).

Environmental Values (pretest-baseline). To assess environmental values, we measured three items (e.g. importance of protecting the environment, preserving nature) (Table 1), which were adapted from Stern and Dietz (1994). Respondents were asked to rate the level of importance on a scale of 1 (not at all important) to 5 (very important). The responses to all three questions were averaged to produce an overall environmental values score ranging from 1 to 5.

Issue Relevance (pretest-baseline). To gauge the issue relevance of climate change to an individual, respondents were asked to indicate how much they thought about climate change before today on a scale of 1 (not at all) 2 (rarely), 3 (occasionally) to 4 (frequently) (Table 1).

Belief Efficacy (pretest-baseline). To assess respondents' perceived efficacy in regards to taking action against climate change we measured one item (Table 1). Respondents were asked to select the statement that came closest to their view about how humans could reduce climate change with possible responses being 1 (Humans can reduce climate change, and we are going to do so successfully), 2 (Humans could reduce climate change, but it's unclear at this point whether we will do what's needed), 3 (Humans could reduce climate change, but people aren't willing to change their behavior so we're not going to change it), and 4 (Human can't reduce climate change, even if it is happening).

Climate Belief – Real (pretest-baseline). Two questions were used to determine whether respondents believed climate change is real (Table 1). The first question asked whether climate change was happening with possible responses being 1 (yes), 2 (no), and 3 (I am not sure). The second question asked how sure individuals were of their response to climate change happening with possible response being 1 (not at all), 2 (a little), 3 (somewhat), 4 (quite), 5 (very), and 6 (not applicable). To combine the questions into a single variable, I recoded the first question so that the "no" responses became a -1 and the "I am not sure" responses because a 0. Then I multiplied the variables against each other such that the new variable will have a scale ranging

from -5 (very sure climate change is not happening) to 5 (very sure climate change is happening).

Climate Belief – Human Caused (pretest-baseline). To determine whether respondents believed climate change is human caused we measured one item (Table 1). Respondents were asked how climate change was caused, assuming that it is happening with possible responses being 1 (caused mostly by humans), 2 (caused mostly by natural changes in the environment), 3 (caused by both human activities and natural changes), 4 (none of the above because it isn't happening). This item had a couple of appropriate answers, so it was recoded in SPSS to represent a binomial variable where 0 = not caused mostly by humans and 1 = caused mostly by humans.

Local Risk Perception (post-test – baseline). Three items were used to assess perceived risks of the impacts of climate change on a personal level (e.g. impact on the health of your family) (Table 1), which were adapted from Leiserowitz (2005). Respondents were asked to rank their perception of risk on a scale of 1 (not at all), 2 (only a little), 3 (a moderate amount), 4 (a great deal), and 5 (don't know). The responses to all three questions were averaged to produce an overall local risk perception score.

Distant Risk Perception (post-test – baseline). Four items were used to assess perceived risks of the impacts of climate change on a global level (e.g. impact on people in developing countries) (Table 1), which were adapted from Leiserowitz (2005). Respondents were asked to

rank their perception of risk on a scale of 1 (not at all), 2 (only a little), 3 (a moderate amount), 4 (a great deal), and 5 (don't know). The responses to all four questions were averaged to produce an overall distant risk perception score.

Individual Efficacy (post-test – baseline). Two items were used to assess individual efficacy (e.g. my actions can slow climate change) (Table 1). Respondents were asked to indicate to which degree they agreed with the statements on a scale of 1 (disagree) to 5 (agree). The responses to the two questions were averaged to produce an overall individual efficacy score ranging from 1(low efficacy) to 5 (high efficacy).

Collective Efficacy (post-test – baseline). Two items were used to assess collective efficacy (e.g. the city can slow climate change) (Table 1). Respondents were asked to indicate to which degree they agreed with the statements on a scale of 1 (disagree) to 5 (agree). The responses to the two questions were averaged to produce an overall collective efficacy score ranging from 1 (low efficacy) to 5 (high efficacy).

Affect (post-test – baseline). To gauge affect we measured one item about respondents being worried about the health impacts associated with climate change (Table 1). Respondents indicated to what degree they agreed with the statement on a scale of 1 (disagree) to 5 (agree).

Responsibility (post-test – baseline). We measured one item to assess respondents' responsibility to address climate change (Table 1). Respondents were asked to indicate to which degree they agreed with the statement that they are responsible to take action against climate change on a scale of 1 (disagree) to 5 (agree).

Policy Support (post-test – baseline). To gauge policy support for climate mitigation initiatives (e.g. mandatory spraying for mosquitoes) we measured four items (Table 1). Respondents were asked to indicate to which degree they supported an initiative on a scale of 1 (oppose), 2 (somewhat oppose), 3 (neither support nor oppose), 4 (somewhat support), and 5 (support). The responses to all four questions were averaged to produce an overall policy support score ranging from 1 (opposition) to 5 (support) where 3 (indifference).

Socio-demographics. The post-test and online surveys concluded with questions about specific socio-demographics, such as the respondent's gender, age, race, level of education, annual household income, political orientation, and political party affiliation. This data was used to describe the sample populations and identify differences between populations.

Table. 1 Survey Measures		
Variable	**Source**	**Item**
Environmental Values		
	Pre-test Online	Importance of protecting the environment, preserving nature Importance of fitting into nature, unity with nature Importance of respecting the earth, harmony with other species. 1=Not at all 2=A little important 3=Somewhat important 4=Quite important 5=Very important
Issue Relevance		

	Pre-test **Online**	Climate change is personally unimportant to me 1=Disagree 2=Somewhat disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
	Pre-test	Thoughts about climate change before today 1=Not at all 2=Rarely 3=Occasionally 4=Frequently
	Online	Survey about climate change is personally relevant to me 1=Disagree 2=Somewhat disagree 3= Neither Agree nor Disagree 4=Somewhat agree 5=Agree Risk of climate change is personally relevant to me 1=Disagree 2=Somewhat disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
Self-Reported Knowledge	**Pre-test** **Online** **Post-Test**	Well informed about climate change 1=Not at all informed 2=A little informed 3=Somewhat informed 4=Well informed 5=Very informed
Climate Belief Real		
	Pre-test **Online**	do you think climate change is happening 1=Yes 2=No 3=I am not sure How sure are you of your response to climate change happening 1=Not at all 2=A little 3=Somewhat 4=Quite 5=Very 6 = Not applicable (skipped if unsure in Q5Pre)
Climate Belief Human-caused		
	Pre-test **Online**	Assuming climate change is happening, do you think it is 1=Caused mostly by human activities 2=Caused mostly by natural changes in the environment 3=Caused by both human activities and natural changes 4=None of the above because it isn't happening
Belief Efficacy		

	Pre-test Online	Which statement comes closest to your view 1=Humans can reduce climate change, and we are going to do so successfully 2=Humans could reduce climate change, but it's unclear at this point whether we will do what's needed. 3=Humans could reduce climate change, but people aren't willing to change their behavior so we're not going to change it. 4=Human can't reduce climate change, even if it is happening.
Affect		
	Post-Test Online	I am worried about health impacts of climate change. 1=Disagree 2=Strongly disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
Responsibility		
	Post-Test Online	To take action to slow climate change. 1=Disagree 2=Strongly disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
Individual Efficacy		
	Post-Test Online	My actions can slow climate change My actions can make me less vulnerable to health impacts 1=Disagree 2=Strongly disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
Collective Efficacy		
	Post-Test Online	The city can help slow down climate change The city can make Columbus less vulnerable to health impacts. 1=Disagree 2=Strongly disagree 3=Neither agree nor disagree 4=Somewhat agree 5=Agree
Local Risk Perception		
	Post-Test Online	
Distant Risk Perception		
	Post-Test Online	
Policy Support		

	Post-Test Online	Create cooling shelters in existing city facilities (Q67_6) Mandatory spraying for mosquitos (Q67_7) Allocate additional city resources to tracking climate change (Q61_5) Develop a "vulnerability map" (Q61_4) 1=Oppose 2=Somewhat oppose 3=Neither support nor oppose 4=Somewhat support 5=Support

3.6 Statistical Analyses

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were obtained through frequency analyses, which quantified responses. Reliability analyses were conducted on multi-item measures, providing a Cronbach's alpha value to measure the reliability of the intended measures in the study. Paired samples t-tests were run to analyze mean difference between paired observations. Independent samples t-tests were run to analyze differences between the means of two independent groups on the continuous dependent variables. Multivariate analysis of covariance was run to analyze the effectiveness of the treatment while controlling for variables that may have confounded the results.

Chapter 4. RESULTS

Data in this section is organized by the order in which the statistical analyses were conducted: descriptive statistics, reliability analyses, independent samples t-test, paired samples t-test, and multivariate analysis of covariance.

4.1 Descriptive Statistics[2]

Of the 649 respondents included in the analysis, 244 belonged to the experimental, pretest and posttest group, and 405 belonged to the control, online survey group. To analyze the socio-demographics and predispositions associated with each sample population, a number of frequency analyses were run. Both the groups were fairly evenly split by gender (+/- 50% male and female). The average age in the control group was 50.6, while the average age in the experimental group was 58 (see Table 2 for a breakdown of the frequencies). Individuals identifying as white composed the majority of the sample in both groups, and both groups had a high percentage of individuals who obtained an Associate's degree or higher at 61.7% for experimental group and 56.9% for the control group. The political affiliation of both groups was even with majority identifying as either Democrat, Republican or Independent, and the same can be said that a moderately even percentage of both groups identified political orientation as liberal or conservative.

"On average, the individuals in my sample tended to be older and more educated than the population of Columbus", etc. etc. You can then give some of your reasons why your samples were different, but don't do any comparing of the samples to each other, those results come later when you report significance tests.

Compared to the population of Columbus, Ohio, the individuals in my samples tended to be more older and educated according to the U.S Census Bureau (2013) (Table 2). This could be due to older people being more likely to be a part of civic organizations, as well as demonstrating more interest to complete surveys. Additionally, there may have been more educated people in attendance to the presentation because educated individuals are more likely to be a part of civic organizations

[2] Statistical comparison of differences between the two groups will be presented in section 4.3

Table 2. Socio-demographic characteristics of the experimental and control group, and city of Columbus, OH

	Experimental Group (%)	*Control Group (%)*	*Columbus, OH (%)*[1]
Gender			
Female	50	48.1	51.2
Male	50	51.9	48.8
Age			
18-29	6.4	13.8	
30-39	8.5	14	
40-49	13.7	17.2	
50-64	40.1	26.8	
65 and older	31.3	28.2	8.6
Race			
White	79.1	84.7	61.5
Black	15	8.2	28
American Indian	2.1	0.2	0.3
Other non-white	3.8	6.9	11.5
Political Party			
Democrat	42	32.2	
Republican	30.8	27.5	
Libertarian	3.6	2.8	
Independent (no leaning toward either party)	21.3	34.8	
Other	2.4	2.8	

Political Orientation			
Very liberal	5.5	4.3	
Liberal	24.2	15.1	
Moderate with liberal leanings	16.4	26.9	
Moderate with conservative leanings	25.5	29.4	
Conservative	8.5	19.9	
Very conservative	20	4.3	
Education			
Less than high school	1.6	1.5	11.7
High School graduate or GED	10.1	13.5	
Some college, business, or technical school	26.6	28.2	
Associate's degree	4.8	7	
Bachelor's degree	33.5	27.2	
Master's degree	16.5	14.5	
Professional degree	2.1	4.5	
Doctoral degree	4.8	3.7	

[1] Source: http://quickfacts.census.gov/qfd/states/39/3918000.html US Census Bureau, 2013

Another key characteristic that described the two sample populations were the pre-disposition of each group such as climate beliefs, environmental values, self-reported values, issue relevance, and belief efficacy. For climate beliefs, majority of both groups believed that climate change was real, but they did not believe that it was not human caused (Table 3). For

environmental values, the majority of the experimental group and control group demonstrated moderate-high or high importance. While 69.5% of the experimental group reported moderate to high environmental values, only 57.4% of the control group did (Table 4).

Table 3. Climate Beliefs Summary - Real and Human Caused

Real	*Experimental Group (%)*	*Control Group (%)*
I am very sure climate change is not happening	3.3	3.2
I am quite sure climate change is not happening	2	4
I am somewhat sure climate change is not happening	.8	1.2
I am a little sure climate change is not happening	.8	1
I am unsure about whether climate change is happening	12.7	0.7
I am a little sure climate change is happening	2	5.7
I am a somewhat sure climate change is happening	11.4	17.8
I am a quite sure climate change is happening	20	24.5
I am a very sure climate change is happening	23.3	22
Human Caused		
Not caused mostly by humans	71.4	81.4
Caused mostly by humans	16.7	18.6

Table 4. Environmental Values Summary - Importance of Treatment of the Environment

	Experimental Group (%)	*Control Group (%)*
Low Importance (1- 1.67)	.8	5.7
Low-Moderate Importance (2-2.67)	4.8	13.4
Moderate Importance (3-3.33)	13.4	23

Moderate - High Importance (3.67-4.33)	33.9	36.7
High Importance (4.67- 5)	35.6	20.7

As for self-reported knowledge, the majority of both the experimental and control groups stated that they felt somewhat informed about climate change with percentages of 37.6 % and 40.3%, respectively (Table 5). Those that stated they felt well informed or very informed represented 27.5% of the experimental group and 25.2% of the control group (Table 5). For issue relevance, about 21.5% of the control group stated that they rarely or not at all thought about climate change and 12.6% of the experimental group stated this (Table 6). Both groups had a majority of participants that thought about climate change occasionally or frequently, with 77.1% of the experimental reporting this and 78.5% of the control group stating this as well (Table 6).

Table 5. Self-reported Knowledge Summary - Sense of Informedness about Climate Change

	Experimental Group (%)	*Control Group (%)*
Not at all informed	5.7	6.7
A little informed	19.6	27.5
Somewhat informed	37.6	40.3
Well informed	21.2	19.3
Very informed	6.1	5.9

Table 6. Issue Relevance Summary - Occurrence of Thoughts about Climate Change

	Experimental Group (%)	*Control Group (%)*
Not at all	2.4	5.2
Rarely	10.2	16.3
Occasionally	46.1	53.5
Frequently	31	25.0

For belief efficacy, the majority of both the experimental and control groups equally believed that humans can reduce climate change, but think it's unclear whether people will do what is needed, with 49.4% of the experimental group and 49% of the control group agreeing with this statement (Table 7). These results directly align with recent findings from a 2013 survey of Columbus Ohioans asking whether people will rally to carry out the necessary tasks to reduce climate change (Leiserowitz et al., 2013). Additionally, the control group was less optimistic about humans' ability to address climate change with 17.8% stating that humans can't reduce climate change, even if it is happening (Table 7).

Table 7. Belief Efficacy Summary - Sense That Humans Can Reduce Climate Change

	Experimental Group (%)	*Control Group (%)*
Humans can reduce climate change, and we are going to do so successfully.	5.7	3
Humans could reduce climate change, but it's unclear at this point whether we will do what's needed.	49.4	49
Humans could reduce climate change, but people aren't willing to change their behavior so we're not going to change it.	16.3	28
Humans can't reduce climate change, even if it is happening.	11.8	17.8
Climate change isn't happening.	3.3	2.2

4.2 Reliability Analyses

There was one measure in the pre-test and online survey/baseline data set that were associated with multiple questions: environmental values and climate belief real. To combine these questions into a single measure, I first had to test if they were reliable together as a measure. The three items in the environmental values measure had a Chronbach's Alpha of 0.907 (Table 8), which indicates a reliable measure since it is above 0.7 (Pallant, 2013).

Table 8. Reliability Testing Results for Pretest and Online Survey/Baseline Data

Variable	Item	Cronbach's Alpha	Alpha if Item Deleted
Environmental Values		0.907	
	Protecting the environment, preserving nature		0.872
	Fitting into nature, unity with nature		0.876
	Respecting the earth, harmony with other species		0.852

There were five measures in the post-test and online survey/baseline data set that were associated with multiple questions: local risk perception, distant risk perception, individual efficacy, collective efficacy, and policy support. For the local risk perception measure, three items had a Chronbach's Alpha of 0.963 (Table 9). The Chronbach's Alpha for the four distant risk perception items was 0.942, which also indicated good internal consistency (Table 9). The two items in the individual efficacy measure, as well as the collective efficacy measure, were highly reliable with a Chronbach's Alpha score of 0.818 and 0.927, respectively (Table 9). Lastly, the policy support measure also demonstrated good internal consistency with a Chronbach's Alpha score of 0.811 (Table 9).

Table 9. Reliability Testing Results for Post-test and Online Survey/Baseline Data

Variable	*Item*	*Cronbach's Alpha*	*Alpha if Item Deleted*
Local Risk Perception		0.963	
	climate change will harm the health of you personally		0.948
	climate change will harm the health of your family		0.928
	climate change will harm the health of people in your community		0.959
Distant Risk Perception		0.942	
	climate change will harm the health of people in the United States		0.919
	climate change will harm the health of people in developing countries		0.923
	climate change will harm the health of people in other modern, industrialized countries		0.911
	climate change will harm the health of future generations of people		0.941
Individual Efficacy		0.818	
	My actions can help slow down climate change		
	My actions can make me less vulnerable to the health impacts of climate change		
Collective Efficacy		0.927	
	The city's actions can help to slow down climate change		
	The city's actions can make Columbus less vulnerable to the health impacts of climate change		
Policy Support		0.811	
	Develop a "vulnerability map" of areas where residents are at the highest risk of climate change-related impacts		0.717

Mandatory mosquito spraying for mosquitos during high risk periods	0.839
Create cooling shelters in existing city facilities during extreme heat waves	0.751
Allocate additional city resources to tracking climate change severity and addressing resulting health impacts	0.722

4.3 Independent Samples t-test

Ideally, I would like for each population to be equal and not demonstrate any significant differences in terms of their demographic characteristics, climate beliefs, environmental values, self-reported knowledge, issue relevance, and belief efficacy that humans can solve climate change. Six independent samples t-tests were run to analyze potential differences in the two sample populations of the study by comparing the pre-test and online survey data set. Ideally, I would like for each population to be equal and not demonstrate any significant differences. Assumptions of the independent samples test were addressed for outliers and normality. The variables were reported individually in my thesis since each variable did not meet the same assumptions. The six variables include: environmental values, issue relevance, self-reported knowledge, climate belief real, climate belief human caused, and belief efficacy.

Environmental values. An independent-samples t-test was run to determine if there were differences in environmental values between attendees of a climate presentation and non-attendees. There were no outliers in the data, as assessed by visual inspection of a boxplot. The assumption of normality was met, as assessed by skewness and kurtosis values (Table 10), and there was not homogeneity of variances, as assessed by Levene's test for equality of variances (p=.001). Participants who attended the presentation had a higher environmental values score (M

= 4.138, *SD* = 0.819) than those who did not attend the presentation *(M* = 3.602, *SD* = 1.008), a statistically significant difference (*M* = -0.536, 95% CI [-0.684, -0.389], *t* (524.389) = -7.149, *p*<.001, *d*= 0.584) (Table 11).

Issue relevance. An independent-samples t-test was run to determine if there were differences in issue relevance between attendees of a climate presentation and non-attendees. Seven outliers were detected, as assessed by visual inspection of a boxplot. Inspection of their values did not reveal them to be extreme and they were kept in the analysis. The assumption of normality was met, as assessed by skewness and kurtosis values (Table 10), and there was homogeneity of variances, as assessed by Levene's test for equality of variances (*p*=.368). Participants who attended the presentation had a higher issue relevance score (*M* = 3.18, *SD* = 0.734) than those who did not attend the presentation *(M* = 2.98, *SD* = 0.789), a statistically significant difference (*M* = -0.195, 95% CI [-0.321, -0.068], *t* (622) = -3.015, *p*= .003, *d*= 0.262) (Table 11).

Self-reported knowledge. An independent-samples t-test was run to determine if there were differences in self-reported knowledge between attendees of a climate presentation and non-attendees. There were no outliers in the data, as assessed by visual inspection of a boxplot. The assumption of normality was met, as assessed by skewness and kurtosis values (Table 10), and there was homogeneity of variances, as assessed by Levene's test for equality of variances (*p*=.619). Participants who attended the presentation had a higher self-reported knowledge score (*M* = 3.03, *SD* = 0.990) than those who did not attend the presentation *(M* = 2.9, *SD* = 0.984), a statistically non-significant difference (*M* = -0.124, 95% CI [-0.286, -0.038], *t* (622) = -1.501, *p*=0.134, *d*= 0.132) (Table 11).

Climate belief real. An independent-samples t-test was run to determine if there were differences in beliefs that climate change is real between attendees of a climate presentation and non-attendees. Seven outliers were detected, as assessed by visual inspection of a boxplot. Inspection of their values did not reveal them to be extreme and they were kept in the analysis. The assumption of normality was violated, as assessed by skewness and kurtosis values (Table 10), and there was homogeneity of variances, as assessed by Levene's test for equality of variances (p=.812). Participants who did not attend the presentation had a higher score in the belief that climate change is real (M = 2.71, SD = 2.75) than those who attended the presentation *(*M = 2.36, SD = 0.2.70), a statistically non-significant difference, (M = -0.34, 95% CI [-0.816, 0.128], t (588) = -1.43, p=0.153, d= -0.13) (Table 11).

Climate belief human caused. An independent-samples t-test was run to determine if there were differences in beliefs that climate change is human-caused between attendees of a climate presentation and non-attendees. Four outliers were detected, as assessed by visual inspection of a boxplot. Inspection of their values did not reveal them to be extreme and they were kept in the analysis. The assumption of normality was violated, as assessed by skewness and kurtosis values (Table 10), and there was homogeneity of variances, as assessed by Levene's test for equality of variances (p=.8). Participants who attended the presentation had a higher score in the belief that climate change is human-caused (M = 0.1898, SD = 0.393) than those who did not attend the presentation *(*M = 0.1856, SD =0.389), a statistically non-significant difference, (M = -0.0042, 95% CI [-0.069, 0.061], t (618) = -0.126, p=0.899, d= -0.011) (Table 11).

Belief efficacy. An independent-samples t-test was run to determine if there were differences in belief efficacy between attendees of a climate presentation and non-attendees. Four outliers were detected, as assessed by visual inspection of a boxplot. Inspection of their values did not reveal them to be extreme and they were kept in the analysis. The assumption of normality was met, as assessed by skewness and kurtosis values (Table 10) and there was homogeneity of variances, as assessed by Levene's test for equality of variances (p=.589). Participants who did not attend the presentation had a higher belief efficacy score (M = 2.67, SD = 0.878) than those who attended the presentation *(*M = 2.51, SD = 0.941), a statistically significant difference, (M = 0.164, 95% CI [0.014, 0.314], t (614) = 2.145, p=.032, d= 0.176) (Table 11).

Overall, the attendees at the climate presentation had stronger environmental values, a greater belief in human ability to address climate change, and more frequent thoughts about climate change. However, the two groups shared similar beliefs related to climate change being real, the likelihood of it being caused by humans, and a similar level of familiarity with climate change.

Table 10. Pretest and Baseline/Online Survey Independent Samples t-test Descriptive Statistics

	N	*Mean*	*Standard Deviation*	*Skewness*	*Kurtosis*
Environmental Values					
Control	402	3.60	1.008	-.495	-.285
Experimental	217	4.14	0.819	-.824	.350
Issue Relevance					
Control	404	2.98	0.789	1.623	.637
Experimental	220	3.18	0.734	1.593	.543
Self-reported Knowledge					
Control	403	2.9	0.984	.148	-.316
Experimental	221	3.03	0.990	-.026	-.306

Climate Belief Human Caused					
Control	404	0.1856	0.3893	1.623	.637
Experimental	216	0.1898	0.39307	1.593	.543
Climate Belief Real					
Control	403	2.3672	2.70233	-1.193	.656
Experimental	187	2.7112	2.750	-1.434	1.255
Belief Efficacy					
Control	404	2.67	0.878	.621	-.386
Experimental	212	2.51	0.941	.919	.273

Table 11. Pretest and Baseline/Online Survey Independent Samples t-test Descriptive Statistics

	Levene's Test for Equality of Variances		*t-test for Equality of Means*				
	F	*Sig.*	*t*	*df*	*Sig 2-tailed*	*Mean Difference*	*Std. Error Difference*
Environmental Values							
Equal Variances Not Assumed	11.066	0.001	-7.149	524.389	0.000	-0.53626	0.07501
Issue Relevance							
Equal Variances Assumed	0.812	0.368	-3.015	622	0.003	-0.195	0.065
Self-reported Knowledge							
Equal Variances Assumed	0.248	0.619	-1.501	622	0.134	-0.124	0.083
Climate Belief Human Caused							
Equal Variances Assumed	0.064	0.8	-0.127	618	0.899	-0.00417	0.03293
Climate Belief Real							
Equal Variances Assumed	0.026	0.812	-1.431	588	0.153	-0.34398	0.24044
Belief Efficacy							
Equal Variances Assumed	0.292	0.589	2.145	614	0.032	0.164	0.076

4.4 Paired Samples t-test

A paired-samples t-test was used to analyze differences in mean scores for the self-reported knowledge variable in the pre-test and post-test data set. Assumptions of the paired samples test were addressed for outliers and normality. Six outliers were detected that were more than 1.5 box-lengths from the edge of the box in a boxplot. Inspection of their values did not

reveal them to be extreme and they were kept in the analysis. The assumption of normality was met, as assessed by skewness and kurtosis values (Table 10). Participants self-reported a higher sense of being knowledgeable about climate change after receiving the presentation (*M*= 3.55, *SD*= 0.871) as opposed to before the presentation (*M*= 3.07, *SD*= 0.995), a statistically significant mean increase of (*M* = 0.481, 95% CI [0.353, 0.610], *t* (188) = 7.381, *p*< .001, *d*=0.536).

4.5. Multivariate General Linear model

A multivariate general linear model was conducted to control for the variables that were statistically significant in the results from the pre-test and baseline independent samples t-test (see Table 13). The independent variable, group, involved two levels: experimental group and control group. The dependent variables were local risk perception, distant risk perception, individual efficacy, collective efficacy, policy support, affect, and responsibility. There were three covariates included in the analysis: environmental values, issue relevance, and belief efficacy. With the inclusion of covariates, the research question then becomes whether the seven dependent variables vary depending on group membership after controlling for the covariates, which differed between the two groups. Some of the assumptions for MANCOVA were violated. In particular, there were non-linear relationships between some of the dependent variables for each group, and several of the dependent variables were skewed. These limitations lower the power of the multivariate test, but I decided to still carry on with the MANCOVA since Schumaker (2015) explains that violation of MANCOVA assumptions are common in experimental design studies, and it was critical that I include the covariates in my analysis.

The multivariate general linear model [between-subjects factor: group (control group, experimental group); covariates: environmental values, issue relevance, belief efficacy] revealed main effects of the group independent variable ($F (1, 554) = 11.62$, $p < .001$, partial $\eta^2 = .145$) and all three covariates, as well. The strength of the relationship between group membership and the dependent variables was not as strong as the covariates', environmental values ($F (1, 554) = 15.14$, $p < .001$, partial $\eta^2 = .181$), issue relevance ($F (1, 554) = 33.54$, $p < .001$, partial $\eta^2 = .329$) and belief efficacy ($F (1, 554) = 25.11$, $p < .001$, partial $\eta^2 = .269$), which all had a larger effect size. This indicates that much of the difference between the control group and the experimental group's post-test scores are largely due to pre-existing differences in the groups, particularly regarding participants' predispositions surrounding environmental values, issue relevance, and belief efficacy. This outcome is most likely due to the nature of our study design, which did not randomly assign participants to a control or experimental treatment group. After adjustment for covariates, the mean scores for all of the dependent variables were still higher for the experimental group than the control group (see Table 12). These results suggest that participation in the climate change communication treatment was at least partially responsible for differences in the dependent variables.

Table 12. Adjusted and Unadjusted Group Means and Variability for Dependent Variables with Environmental Values, Issue Relevance, and Belief Efficacy as Covariates

Local Risk Perception Measured on a scale of 1 (not at all) to 5 (don't know)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	2.72	1.08	2.78	.048
Experimental Group	161	3.10	.925	2.94	.077

Distant Risk Perception Measured on a scale of 1 (not at all) to 5 (don't know)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.26	.953	3.32	.040
Experimental Group	161	3.31	.843	3.28	.065

Individual Efficacy Measured on a scale of 1 (disagree) to 5 (agree)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.23	1.11	3.13	.045
Experimental Group	161	4.04	1.03	3.85	.072

Collective Efficacy Measured on a scale of 1 (disagree) to 5 (agree)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.53	1.18	3.61	.047
Experimental Group	161	4.13	1.14	3.91	.076

Policy Support Measured on a scale of 1 (oppose) to 5 (support)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.70	.866	3.77	.039
Experimental Group	161	4.02	.929	3.85	.062

Affect Measured on a scale of 1 (disagree) to 5 (agree)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.49	1.23	3.60	.048
Experimental Group	161	4.12	1.10	3.86	.076

Responsibility Measured on a scale of 1 (disagree) to 5 (agree)

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Control Group	398	3.59	1.23	3.69	.044
Experimental Group	161	4.28	.989	4.02	.070

Note: N = number of participants, M = Mean, SD = Standard Deviation, SE = Standard Error, Control Group = Non-recipients of climate change communication treatment, Experimental Group =

There was a statistically significant effect of the treatment on five variables including individual efficacy ($F (1, 554) = 38.33$, $p < .001$, partial $\eta^2 = .065$), collective efficacy, ($F (1, 554) = 10.67$, $p < .001$, partial $\eta^2 = .019$), responsibility ($F (1, 554) = 15.25$, $p < .001$, partial $\eta^2 = .027$),

and affect ($F (1, 554) = 8.31$, $p < .001$, partial $\eta^2 = .015$) (Table 13). The belief efficacy covariate had the strongest effect on responsibility, ($F (1, 554) = 136.07$, $p < .001$, partial $\eta^2 = .197$), individual efficacy ($F (1, 554) = 113.37$, $p < .001$, partial $\eta^2 = .170$), and collective efficacy, ($F (1, 554) = 122.72$, $p < .001$, partial $\eta^2 = .181$) (Table 15). For affect, differences in scores were mostly attributed to environmental values, ($F (1, 554) = 69.29$, $p < .001$, partial $\eta^2 = .111$), and belief efficacy ($F (1, 554) = 65.18$, $p < .001$, partial $\eta^2 = .105$) (Table 13).

Particularly focusing on the effect size of the climate presentation, the treatment was not responsible for a great amount of variance for each dependent variable. In fact, all of the effect size scores were lower than those of the covariates (see Table 13). The strongest influence that the treatment had was attributed to individual efficacy, ($F (1, 554) = 38.33$, $p < .001$, partial $\eta^2 = .065$) (Table 13). This data means that the treatment was most and successful in raising the belief that individuals can act to reduce climate change.

Variables that were not significantly affected by the treatment showed a consistent pattern of being mostly affected by environmental values and belief efficacy. Policy support was moderately affected by belief efficacy ($F (1, 554) = 42.30$, $p < .001$, partial $\eta^2 = .071$), but the strongest main effect was attributed to environmental values ($F (1, 554) = 65.15$, $p < .001$, partial $\eta^2 = .105$) (Table 13). Additionally, an interesting relationship was observed between the differences in covariate effect sizes for distant risk perception and local risk perception. While the strongest main effect for distant risk perceptions is attributed to belief efficacy, the main effect for local risk perception is evenly and moderately attributed to both environmental values ($F (1, 554) = 31.83$, $p < .001$, partial $\eta^2 = .054$), and belief efficacy, ($F (1, 554) = 28.90$, $p < .001$, partial $\eta^2 = .050$), with environmental values being slightly stronger (Table 13).

Table 13. Multivariate General Linear Model Summary

	F	*Sig.*	*Partial Eta Squared*
Covariate: Environmental Values			
Distant Risk Perception	33.805	0.000	0.058
Local Risk Perception	31.83	0.000	0.054
Individual Efficacy	48.847	0.000	0.081
Collective Efficacy	54.529	0.000	0.09
Policy Support	65.154	0.000	0.105
Affect	69.29	0.000	0.111
Responsibility	80.374	0.000	0.127
Covariate: Issue Relevance			
Distant Risk Perception	3.281	0.071	0.006
Local Risk Perception	1.092	0.297	0.002
Individual Efficacy	4.073	0.044	0.007
Collective Efficacy	4.257	0.04	0.008
Policy Support	2.275	0.132	0.004
Affect	35.072	0.000	0.06
Responsibility	27.011	0.000	0.046
Covariate: Belief Efficacy			
Distant Risk Perception	71.619	0.000	0.114
Local Risk Perception	28.902	0.000	0.05
Individual Efficacy	113.366	0.000	0.17
Collective Efficacy	122.724	0.000	0.181
Policy Support	42.298	0.000	0.071
Affect	65.183	0.000	0.105
Responsibility	136.071	0.000	0.197
Group: Experimental/Control			
Distant Risk Perception	0.232	0.63	0.000
Local Risk Perception	3.007	0.083	0.005
Individual Efficacy	38.33	0.000	0.065
Collective Efficacy	10.666	0.001	0.019
Policy Support	1.348	0.246	0.002
Affect	8.314	0.004	0.015
Responsibility	15.246	0.000	0.027

Chapter 5. Discussion

The goal of this study was to test the effect of a communication effort targeting four critical beliefs (i.e., climate change is real, human-caused, dangerous - interpreted as risk perception, and solvable - interpreted as efficacy) on public risk perception, individual and collective efficacy, and support for climate mitigation policy. The existing research indicates that belief in these four key beliefs play an important role in increasing the likelihood for individuals to engage in behaviors (i.e. policy support, climate activism) that address climate change (Ding et al., 2011; Krosnick et al., 2006: Roser-Renouf et al., 2014; van Der Linden et al., 2015). Moreover, surveys particularly of Columbus, Ohio residents suggest that most people believe climate change can be reduced, but doubt that the appropriate collective action will occur to carry out necessary tasks, such as voting to establish climate policy (Leiserowitz et al., 2013).

First off, there were differences present between the two sample populations of people who attended the climate change presentation (experimental group) and people who did not attend the presentation (control group). Particularly, the environmental values, issue relevance, and belief efficacy scores of the two groups were statistically significant, which indicated a potential bias in our experimental sample. Amongst the experimental group, individuals were more environmentally inclined than those in the control group, in terms of the strength of their environmental values and the frequency in which they thought about climate change. According to the literature, individuals with strong environmental values are more likely to demonstrate greater concern and action towards addressing climate change, than those who do not hold those values (Kellstedt et al., 2008; Slimak and Dietz, 2006). Additionally, the control group also demonstrated bias with a higher belief in human ability to reduce climate change. These biases can be problematic when trying to determine the effectiveness of the communication treatment

as they may mask the effect of the treatment given the two groups did not start with similar scores on the various measures of interest.

Taking this into consideration, I then controlled for the environmental values, issue relevance, and belief efficacy variables in the multivariate general linear model analyses to eliminate biases between the populations. Before the covariates were factored in, the experimental group had higher mean scores in all of the dependent variables. After the covariates were applied, most of the dependent variables still had higher mean scores in the experimental group, except for distant risk perception, which had a slightly higher mean score in the control group. Moreover, I did find that the mean scores for all of the dependent variables changed in a similar pattern. The unadjusted and adjusted mean scores for the dependent variables decreased in the experimental group and increased in the control group (see Table 14), thus decreasing the overall difference between the two groups as a result of the treatment. This shows that the three covariates did indeed have a significant influence of the mean scores and that controlling for them helped lessen the impact of pre-existing differences between the two groups.

Although initial review of the mean score results suggest that the climate change treatment was highly effective, due to consistently higher mean scores in the experimental group, this was not the case. In order to gauge the direct impact of the climate change communication treatment, I had to closely analyze the effect of the communication treatment, as it pertained to each dependent variable. As reported in the results section, self-reported knowledge, individual efficacy, collective efficacy, affect, and responsibility were statistically significant for the communication treatment. In other words, the presentation directly increased how knowledgeable individuals believe they are about climate change, strengthened their belief that they can address climate change as an individual and with others, heightened how much they are

worried about the health impacts of climate change, and increased their sense of responsibility for addressing climate change. Thus, my second hypothesis is supported by this data. Considering that the majority of the sample populations both believed that climate change was real, but not human caused, this might mean that belief that climate change is human caused is not necessary to have heightened levels of responsibility and efficacy to address it as a problem. Also, the results from the paired sample t-test showed that self-reported knowledge increased as a result of the presentation, indicating that the presentation was effective in informing the audience.

Alternatively, the presentation did not significantly impact distant risk perception, local risk perception, or policy support for climate mitigation efforts. Thus, my first hypothesis and my last hypothesis are not supported by my results. Focusing on risk perception, it was a disappointment to see that the communication effort was not successful in raising local risk perception, given that the presentation was framed specifically towards Columbus, Ohioans on a local level. However, as mentioned earlier, the presentation did increase concern about health impacts, which was the focus of the local messaging. At first glance, our findings of minimal change in risk perception seems to support Leiserowitz (2006) research that suggests that Americans generally don't perceive climate risks to strongly affect their local communities. However, when closely analyzing the local and distant risk perception scores, the scores in the descriptive statistics showed that local and distant risk perception were close to 3 (moderate concern) or higher for both groups based on a scale of concern for health impacts ranging from 1(not at all) to 4(a great deal) (Table 12). Taking this into consideration, the non-significant change in risk perception can therefore be interpreted as an indicator that participants of the presentation and control group both already had a heightened sense of risk perception. This scenario may be due

to a ceiling effect attributed to the design of the survey scale, where respondents may have been limited by a range of only four answer choices to describe their perception of risk. As a result, a major difference in scores is difficult to detect. Even though change in risk perception scores was minimal, it didn't appear to negatively affect the level of efficacy or responsibility individuals felt to address climate change since these values did increase based on the presentation. This could possibly mean that the presentation may not have increase perceptions of risk or worry, due to a ceiling effect, but did increase belief in the ability to address these issue, hence the increase in individual and collective efficacy.

As for a lack of change in policy support for climate mitigation activities, this result was the most interesting. Although individual and collective efficacy levels were heightened, this did not translate to an increase in support of climate-related policies. Justification for this result may be due to the low scores in risk perception. According to numerous studies, risk perception is a key factor influencing whether an individual will support environmental policies (Kahan et al., 2012; Leiserowitz, 2006; Lorenzoni and Pidgeon, 2006; Weber, 2006). However, researchers generally make this point in the context of promoting localized communication efforts (Leiserowitz, 2006; Lorenzoni and Pidgeon, 2006) or framing the issue as a public health problem (Kleim, 2008; Maibach et al., 2010), which my study actually did as well, and yet I did not receive similar results.

Although the communication treatment did have an effect on some of the dependent variables, it was consistently a minor effect, as assessed by analyzing the effect size, partial eta squared (see table 15). Instead, much of the variance for these dependent variables were attributed to covariates, particularly environmental values and belief efficacy. These results demonstrate that environmental values and belief efficacy predispositions that individuals hold

are highly influential on their perception of climate change. This is especially important for the variables of risk perception, policy support, being worried about the impacts of climate change, and feeling of efficacy and responsibility to take action to reduce climate change. Thus, predispositions such as environmental values and belief efficacy must be considered when trying to increase public engagement with climate change. These findings align with numerous research studies that highlight emphasis on designing future climate change communication interventions by tailoring messages to include content that resonate with an audiences values (Kahan, Jenkins-Smith, & Braman, 2011; Kellstedt et al., 2008; Slimak and Dietz, 2006; Weber and Stern, 2011). Particularly focusing on low-income communities, an audience that probably is most concerned about the financial and health impacts of climate change, I would suggest that communicators incorporate information into their interventions that specifically address key issues that this community would rank as most important. For example, if the presenter wants to increase policy support for climate mitigation activities, they might be better off focusing on climate policies that are low-cost and don't seem threatening to essential social services. Previous research demonstrated that such an ego-environmentalist view holds that individuals are more likely to support mitigation efforts as long as they aren't perceived to threaten their jobs, limit their personal freedoms, or hurt the economy (O'Connor et al., 2002). This isn't to say that everyone in this cultural segment will hold strong values and, accordingly, show more concern and willingness to act. On the contrary, those who demonstrate low strength in these values might be able to relate to a culture-specific message design, but this does not mean that emphasis on these culturally relevant values will be the main factor that influences their concern or willingness to engage in the issue at hand. In this case, it becomes difficult to determine what triggers each individual to become more interested and involved in an issue. Future research can further

explore how to engage members of an audience who hold certain environmental values that aren't strong by finding ways to leverage this slight inclination. Additionally, the large strength of environmental values amongst both sample populations may have misrepresented the population of Columbus, Ohio due to the increased percentages of educated and older survey participants. This must be taken into account when evaluating the results. However, further research can focus on these characteristics can enhance the effectiveness of climate change communication efforts.

However, given this information, I still posit that future research should further explore the relationship between environmental values as it relates to numerous variables including efficacy, policy support, and risk perception. This characteristic seemed to be the most significant in affecting the outcomes of the dependent variables and is greatly related to the personal experience of climate change. Tapping into this area may help close the gap of psychological distance when it comes to belief in climate change and perceiving it as a local risk. Additionally, despite efficacy to address climate change being high, the scores for perception of risk and policy support were still relatively low.

Moreover, since environmental values and belief efficacy were highly instrumental as covariates in affecting risk perception and policy support, further research on how to leverage these characteristics in the design of climate change messages can be beneficial to improving the effectiveness of interventions to catalyze citizens into climate activism. The difficulty in changing values will pose a challenge for researchers, so it may be the best strategy to just meet individuals in the middle to increase support for climate mitigation policy. That is, enhance explanations of how particular climate events may disrupt the culture of the individuals to increase risk perception and then introduce solutions that can avoid this from happening, which

will increase efficacy. My hope is that by making the solutions to climate change events more personal and relatable to a person's culture, or way of life, it will prompt them to take on a protective perspective to securing the things they value the most. In short, most people do not like change, so I think communicators should leverage unwanted change as a reason for people to act to reduce the impacts of global warming.

Bibliography

Anderson, A. W., (2012). New Ecological Paradigm (NEP) Scale. In *Berkshire Encyclopedia of Sustainability: Measurements, Indicators, and Research Methods for Sustainability*. (pp. 260-262). Berkshire Publishing Group.

Arcury, T. (1990). Environmental attitude and environmental knowledge. *Human organization*, *49*(4), 300-304.

Bord, R. J., O'Connor, R. E., & Fisher, A. (2000). In what sense does the public need to understand global climate change?. *Public Understanding of Science*, *9*(3), 205-218.

Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*, *1*(9), 462-466.

Finkel, S. E., Muller, E. N., & Opp, K. D. (1989). Personal influence, collective rationality, and mass political action. *American Political Science Review*, *83*(03), 885-903.

Fischhoff, B. (1995). Risk perception and communication unplugged: Twenty years of process1. *Risk analysis*, *15*(2), 137-145.

Gross, A. G. (1994). The roles of rhetoric in the public understanding of science. *Public understanding of science*, *3*(1), 3-23.

Kahan, D. M., Jenkins-Smith, H., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research*, *14*(2), 147-174.

Kahan, D. M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D., & Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change*, *2*(10), 732-735.

Kahlor, L., & Rosenthal, S. (2009). If we seek, do we learn? Predicting knowledge of global warming. *Science Communication*, *30*(3), 380-414.

Kleim, M. E. (2008). Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *American journal of preventive medicine*, *35*(5), 508-516.

Kellstedt, P. M., Zahran, S., & Vedlitz, A. (2008). Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. *Risk Analysis*, *28*(1), 113-126.

Krosnick, J. A., Holbrook, A. L., Lowe, L., & Visser, P. S. (2006). The origins and consequences of democratic citizens' policy agendas: A study of popular concern about global warming. *Climatic change*, *77*(1-2), 7-43.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic change*, *77*(1-2), 45-72.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2011). Global warming's six Americas, May 2011. *Yale University and George Mason University*.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., Feinberg, G., Rosenthal, S., & Marlon, J. (2014). Climate change in the American mind: Americans' global warming beliefs and attitudes in November, 2013. *Yale Project on Climate Change Communication: Yale University and George Mason University. New Haven, CT*.

Leshner, A. I. (2003). Public engagement with science. *Science (New York, NY)*, *299*(5609), 977-977.

Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climatic change*, *77*(1-2), 73-95.

Maibach, E. W., Leiserowitz, A., Roser-Renouf, C., & Mertz, C. K. (2011). Identifying like-minded audiences for global warming public engagement campaigns: An audience segmentation analysis and tool development. *PloS one*, *6*(3), e17571.

Maibach, E. W., Nisbet, M., Baldwin, P., Akerlof, K., & Diao, G. (2010). Reframing climate change as a public health issue: an exploratory study of public reactions. *BMC Public Health*, *10*(1), 299.

Maibach, E. W., Roser-Renouf, C., & Leiserowitz, A. (2008). Communication and marketing as climate change–intervention assets: A public health perspective. *American journal of preventive medicine*, *35*(5), 488-500.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, *29*(5), 633-647.

McBean, G. A., & Hengeveld, H. G. (2000). Communicating the science of climate change: A mutual challenge for scientists and educators. *Canadian Journal of Environmental Education (CJEE)*, *5*(1), 9-25.

McCaffrey, M. S., & Buhr, S. M. (2008). Clarifying climate confusion: addressing systemic holes, cognitive gaps, and misconceptions through climate literacy. *Physical Geography*, *29*(6), 512-528.

Myers, T. A., Maibach, E. W., Roser-Renouf, C., Akerlof, K., & Leiserowitz, A. A. (2013). The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, *3*(4), 343-347.

Nisbet, M. C. (2009). Communicating climate change: Why frames matter for public engagement. *Environment: Science and Policy for Sustainable Development, 51*(2), 12-23.

O'Connor, R. E., Bord, R. J., Yarnal, B., & Wiefek, N. (2002). Who wants to reduce greenhouse gas emissions?. *Social Science Quarterly, 83*(1), 1-17.

Pallant, J. (2013). *SPSS survival manual*. McGraw-Hill Education (UK).

Pidgeon, N., & Fischhoff, B. (2011). The role of social and decision sciences in communicating uncertain climate risks. *Nature Climate Change, 1*(1), 35-41.

Rabinovich, A., & Morton, T. A. (2012). Unquestioned answers or unanswered questions: Beliefs about science guide responses to uncertainty in climate change risk communication. *Risk Analysis, 32*(6), 992-1002. (Reference for T-test information)

Roser-Renouf, C., Maibach, E. W., Leiserowitz, A., & Zhao, X. (2014). The genesis of climate change activism: from key beliefs to political action. *Climatic change, 125*(2), 163-178.

Schmidt, C. W. (2010). A closer look at climate change skepticism. *Environmental health perspectives, 118*(12), A536-A540.

Slimak, M. W., & Dietz, T. (2006). Personal values, beliefs, and ecological risk perception. *Risk analysis, 26*(6), 1689-1705.

Sturgis, P., & Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public understanding of science, 13*(1), 55-74.

United States Census Bureau. (June 30, 2015). Columbus (city), Ohio [Data file]. Retrieved from http://quickfacts.census.gov/qfd/states/39/3918000.html

Van der Linden, S., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. (2015). The scientific consensus on climate change as a gateway belief: Experimental evidence. *PloS one*, *10*(2), e0118489.

Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change*, *77*(1-2), 103-120.

Weber, E. U. (2010). What shapes perceptions of climate change?. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(3), 332-342.

Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. *American Psychologist*, *66*(4), 315.

Appendix A: Climate Change Presentation

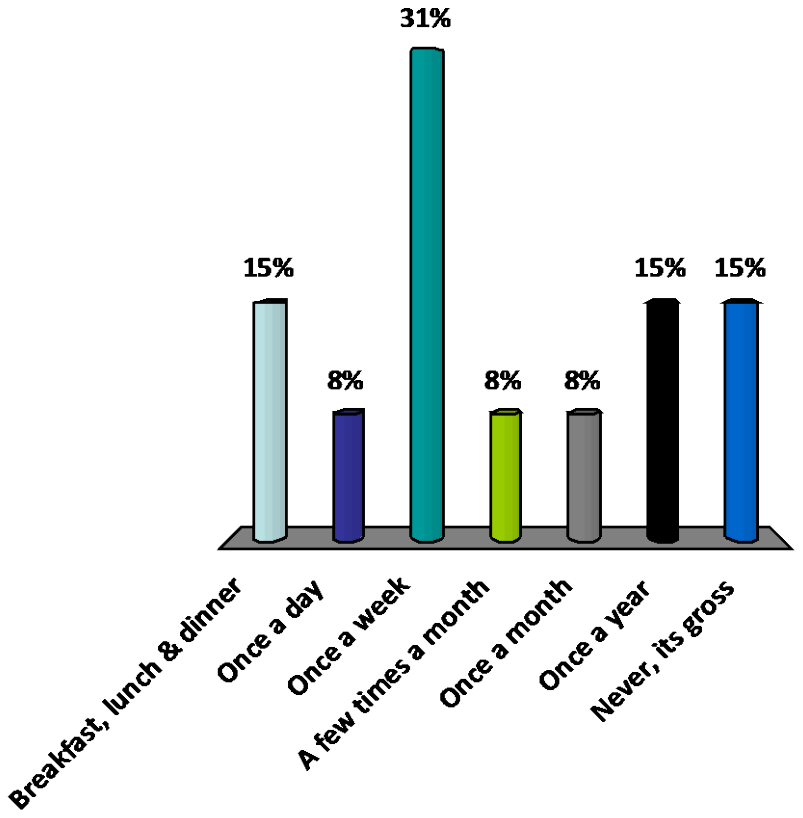
Climate Change in Central Ohio: Why We Should Act

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

THE CITY OF COLUMBUS
MICHAEL B. COLEMAN, MAYOR
COLUMBUS PUBLIC HEALTH

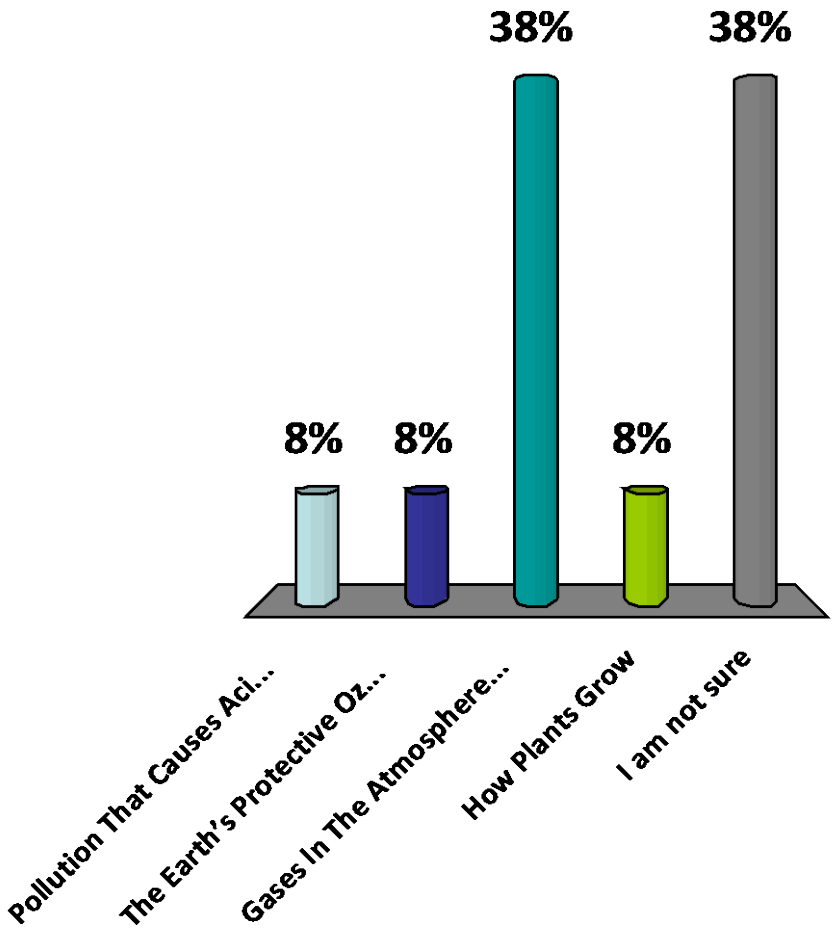
How many times a month do you eat pizza?

1. Breakfast, lunch & dinner
2. Once a day
3. Once a week
4. A few times a month
5. Once a month
6. Once a year
7. Never, its gross



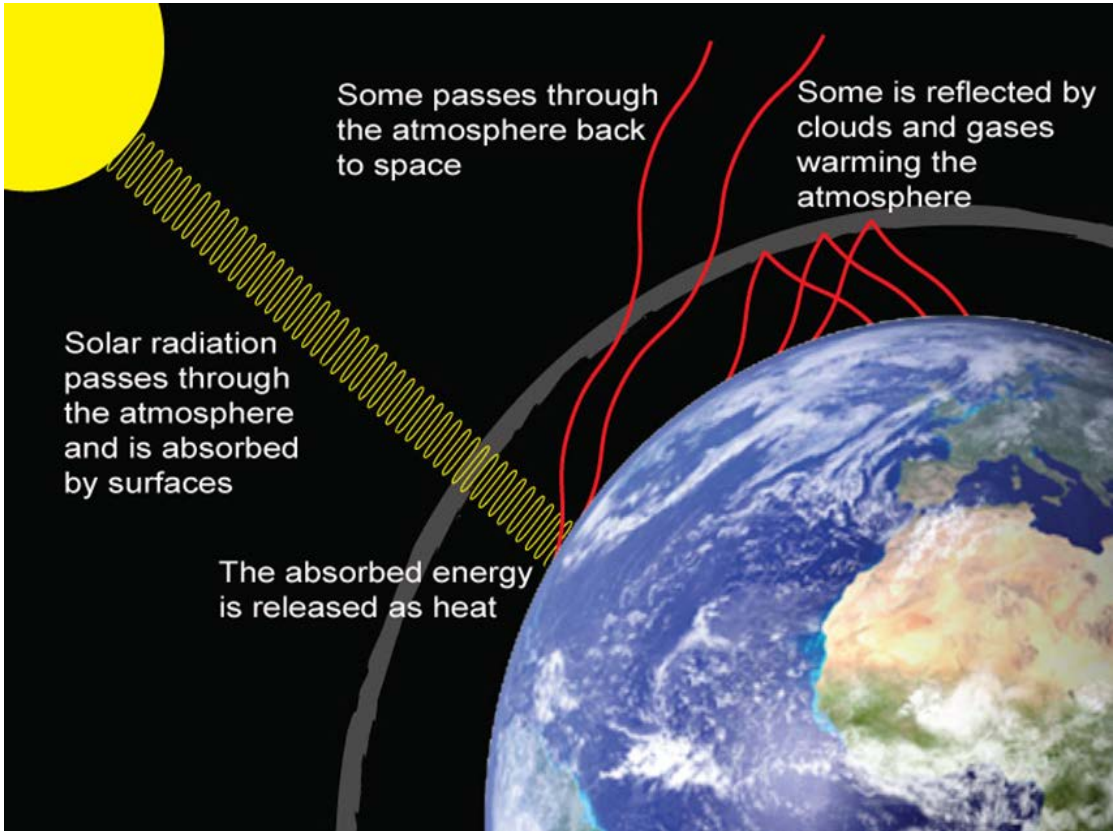
The “Greenhouse Effect” Refers To:

1. Pollution That Causes Acid Rain
2. The Earth’s Protective Ozone Layer
3. Gases In The Atmosphere That Trap Heat
4. How Plants Grow
5. I am not sure



The Greenhouse Effect

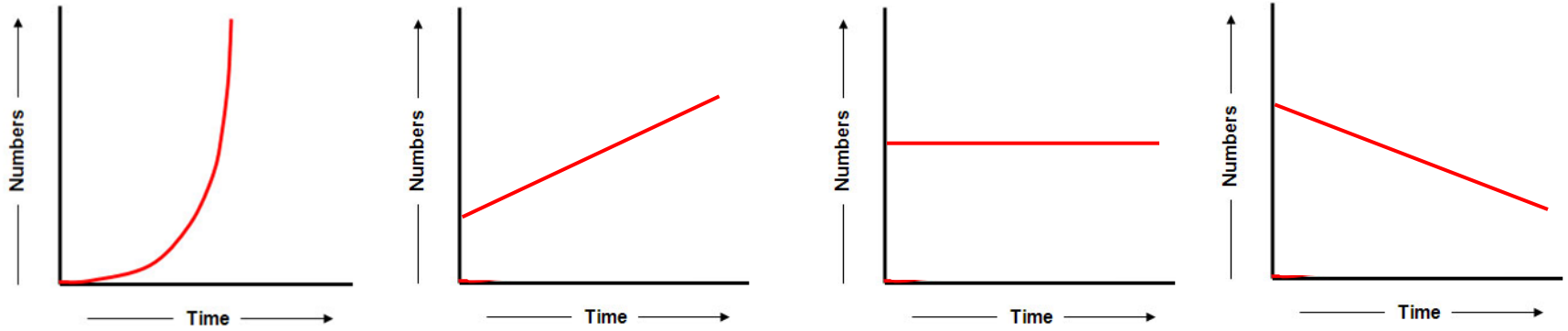
- The sun generates light and heat
- Gases – like carbon dioxide - in the atmosphere trap heat
- This effect allows Earth to support life
- Isn't this good?
  - Too many gases equals too much heat



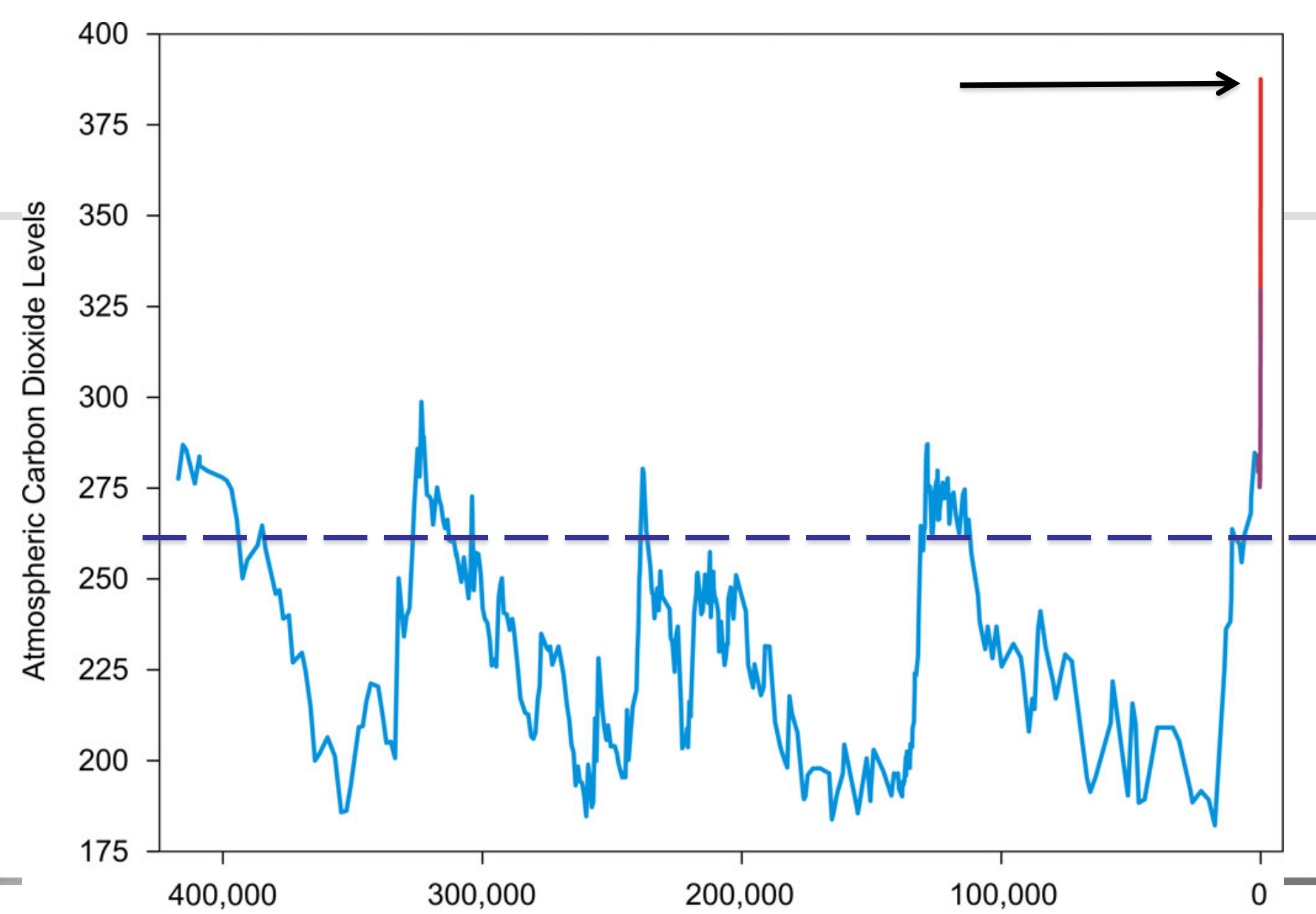
Note 1. IPCC glossary, 2013

Since 1850, the amount of greenhouse gases (such as carbon dioxide) in the atmosphere have been…

1. Rapidly increasing
2. Steadily increasing
3. Staying the same
4. Steadily decreasing
5. I am not sure



Note 2. Scripps Institute, 2013



Note 6. Hansen, 2005; Ogburn, 2013

Climate change is real

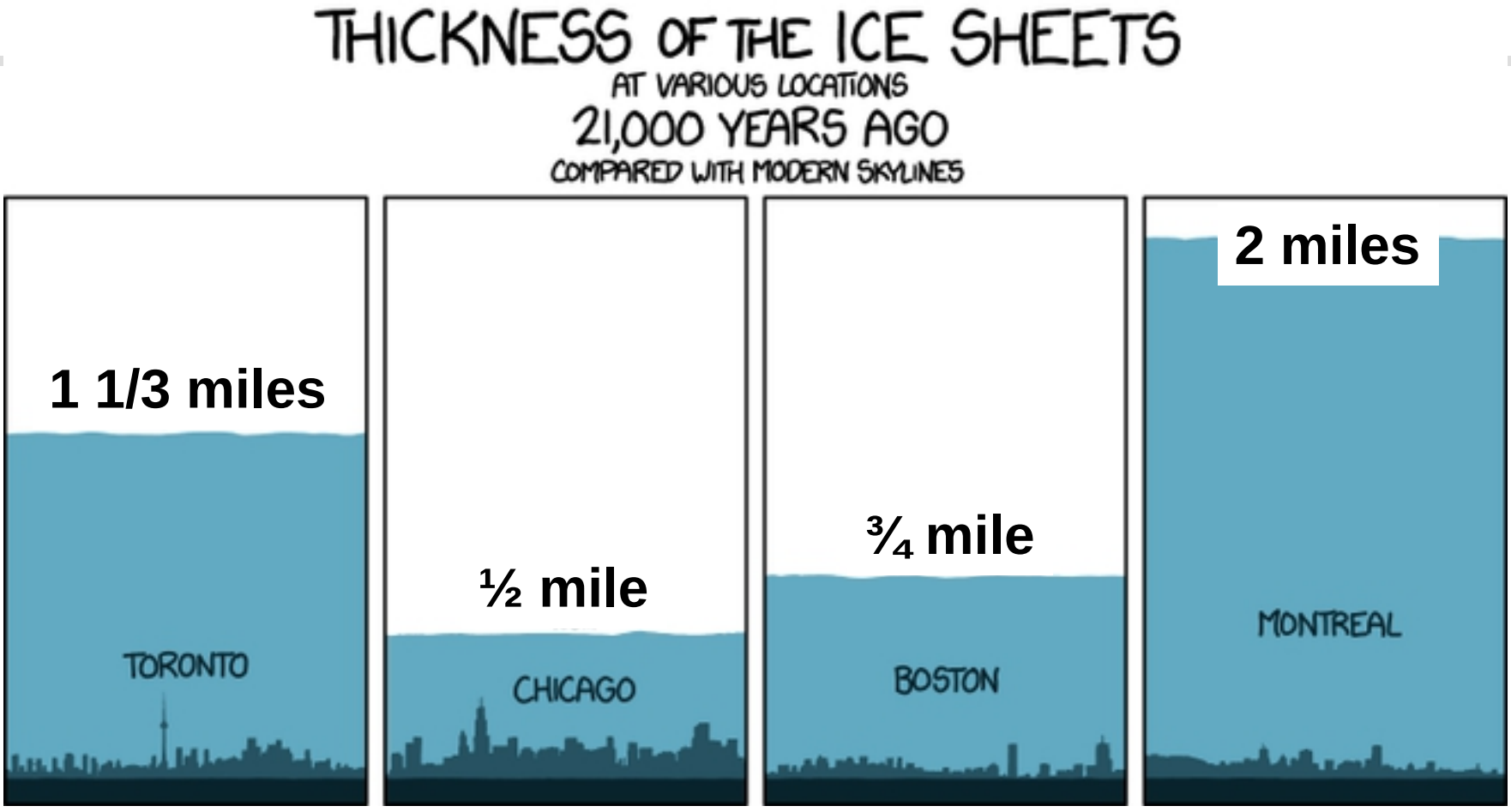
- Weather - what's happening right now
  - It is hot today in Columbus!
- Climate - general weather characteristics of a region
  - Ohio is typically hot and humid in the summer!
- Climate change - trends in the weather observed in a region over a long period
  - Ohio summers are getting hotter!

Climate change is real

- Global temperatures have been generally stable
  - In the last 10,000 years, global average temperatures ranged only 2^0 F warmer or 2^0 F cooler than today
- But small changes = BIG impacts
  - 20,000 years ago, global average temps were about 9^0 F cooler than today – and that caused the Ice Age!

Note 3. Hansen et al., 2012

Climate change is real



Note 4. Dyke et al., 2002

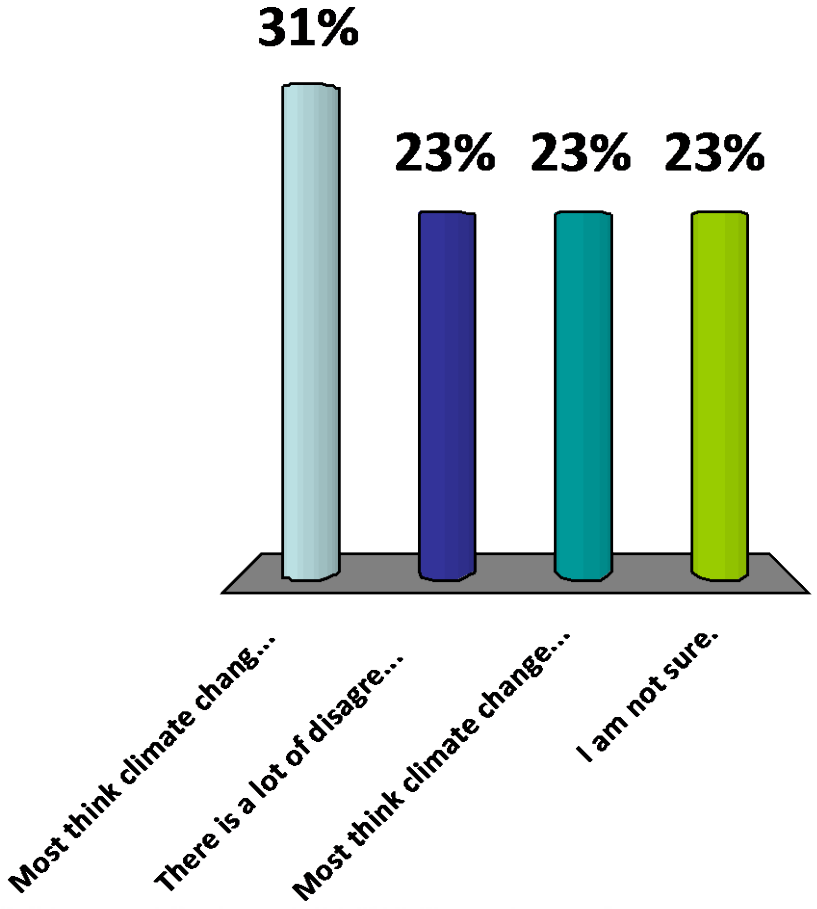
Climate change is real

- Global temperatures are generally stable
  - In the last 10,000 years, global average temperatures ranged only 2^0 F warmer or cooler than today
- But small changes = BIG impacts
  - 20,000 years ago, global average temps were about 9^o F cooler than today – and that caused the Ice Age!
- Global temperatures today are less stable
  - In the last 250 years, global average temps have already increased almost 1.5^o F – that is fast warming!

Note 5. Hansen et al., 2010

Which comes closest to your own view? **Among the world's scientists…**

1. Most think climate change is caused by humans.
2. There is a lot of disagreement over whether or not climate change is caused by humans.
3. Most think climate change is not caused by humans.
4. I am not sure.



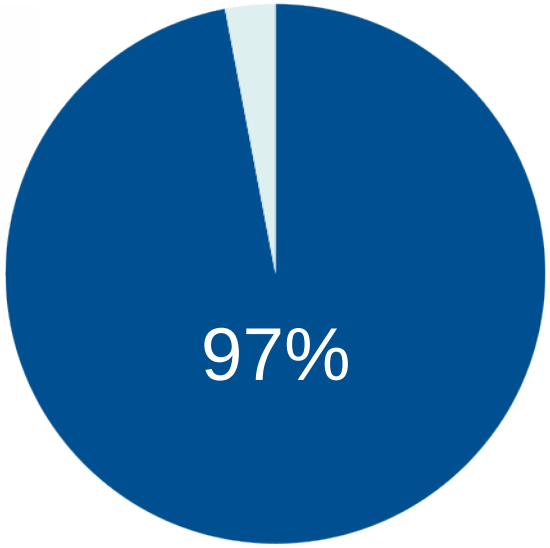
Climate change is real and caused by people

Based on the evidence, 97% of climate scientists have concluded that human-caused climate change is happening.

American Association for the Advancement of Science

AAAS

ADVANCING SCIENCE, SERVING SOCIETY

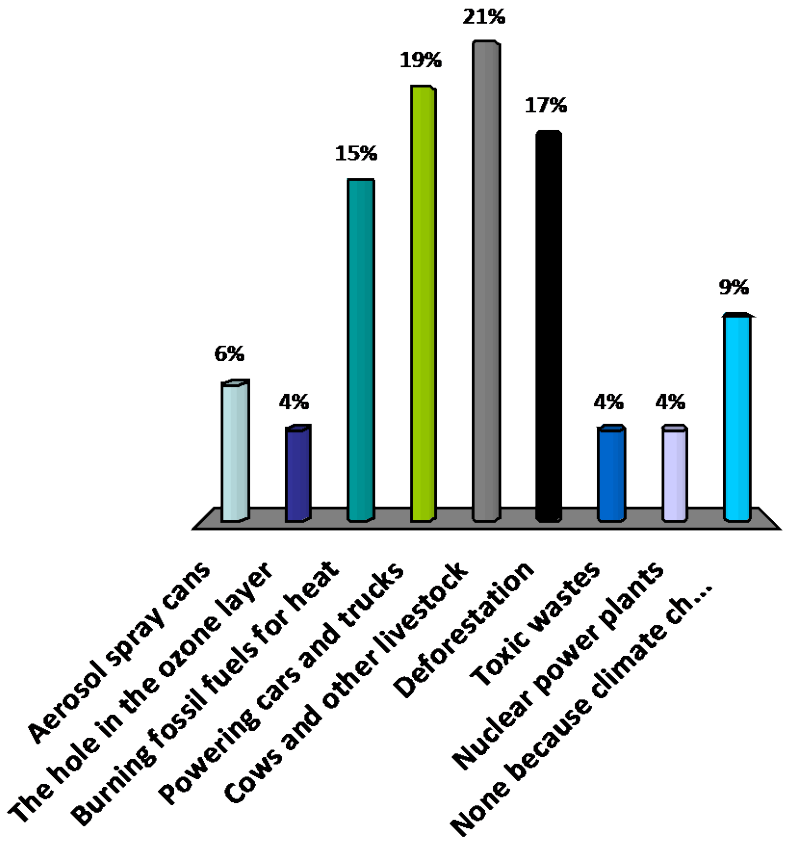


Note 7.

Climate change is real and caused by people

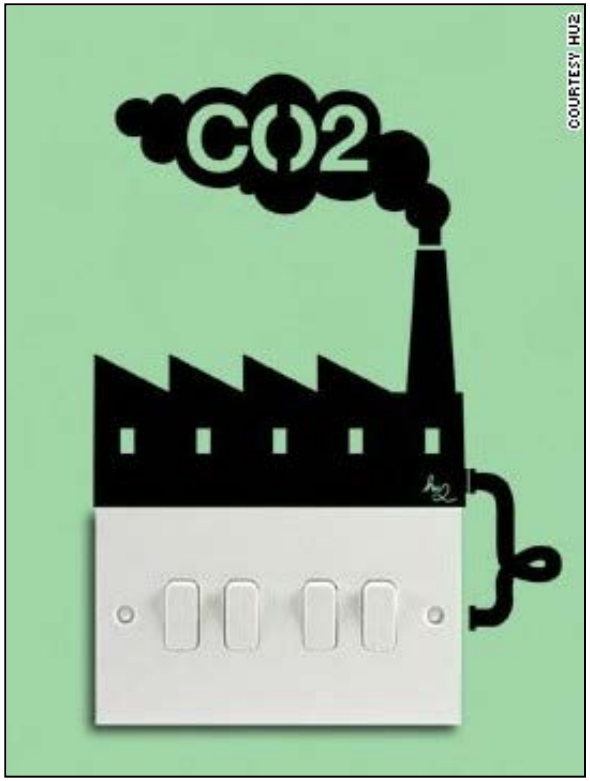
Which of the following, if any, contributes to climate change (Select all that apply)

1. Aerosol spray cans
2. The hole in the ozone layer
3. Burning fossil fuels for heat and electricity
4. Powering cars and trucks
5. Cows and other livestock
6. Cutting down forests
7. Toxic wastes
8. Nuclear power plants
9. None because climate change is not happening



Climate change is real and caused by people

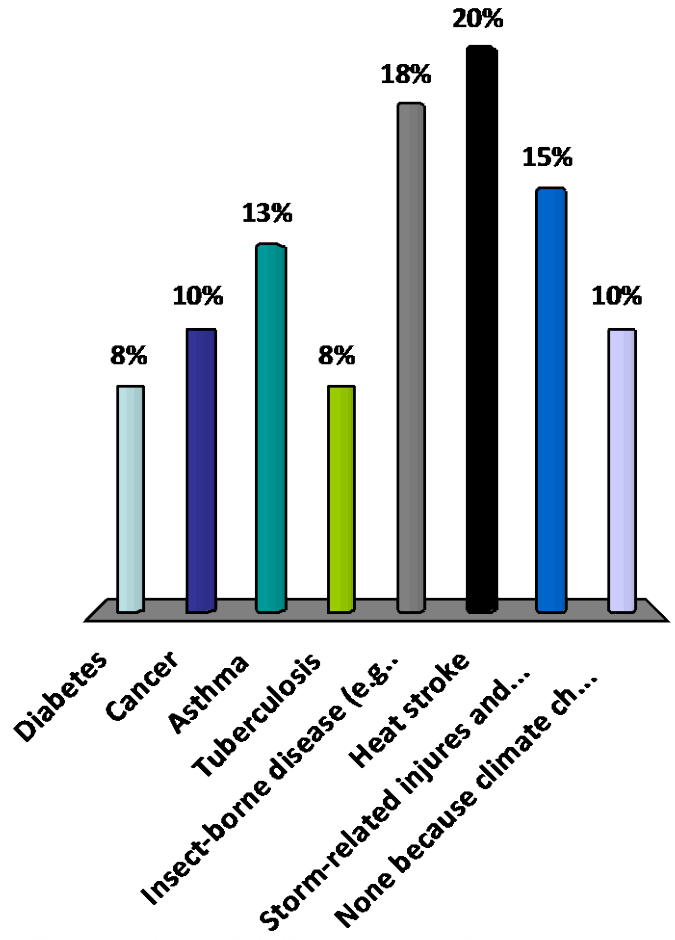
- The burning of fossil fuels (coal, oil) produces carbon dioxide:
  - Transportation (cars, buses, planes)
  - Energy production (electricity, heating/cooling)
- Industry (manufacturing/production) produces methane
- Cutting down forests reduces the carbon storage capacity of the Earth



Note 8. US EPA, 2013

Climate change will result in more of the following health problems…(Select all that apply)

1. Diabetes
2. Cancer
3. Asthma
4. Tuberculosis
5. Insect-borne disease (e.g., West Nile Virus)
6. Heat stroke
7. Storm-related injures and deaths
8. None because climate change is not happening



Climate change is bad for Ohio

Extreme weather

- More severe heat and related air quality issues
- Stronger, more frequent storms: blizzards, floods, tornados, straight line winds, etc.

Note 9. US Global Change Research Program, 2009; Climate Change Science Program, 2008; USEPA 2010

The Columbus Dispatch

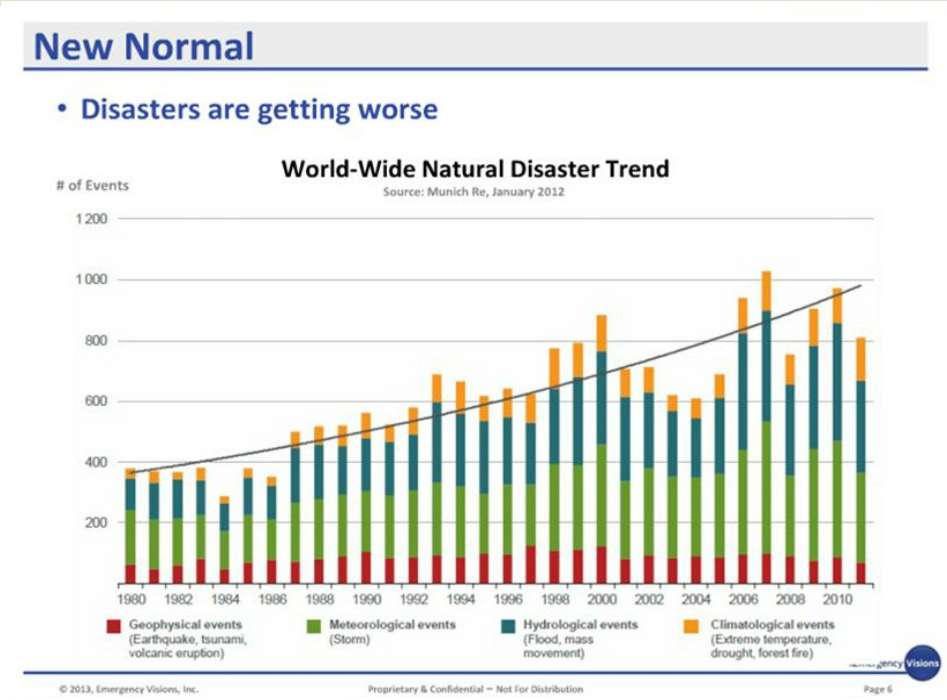
Midwest could see damaging winds from derecho

Tuesday June 11, 2013 5:00 PM

This house at the intersection of Milton Avenue and Montrose Way in Clintonville was hit by a fallen tree during a June 2012 storm, with a significant portion of it on top of the house. Courtney Hergesheimer | Dispatch

2012-2014 Top 10 Hazards for Franklin County

1. **Tornado**
2. **Dam Failure**
3. **Flooding**
4. WMD Terrorist Incident
5. Cyber-Terrorism
6. **Infectious Disease**
7. **Severe Winter Weather**
8. Hazardous Material Incident
9. Transportation Accident – Aircraft
10. **Severe Summer Weather**

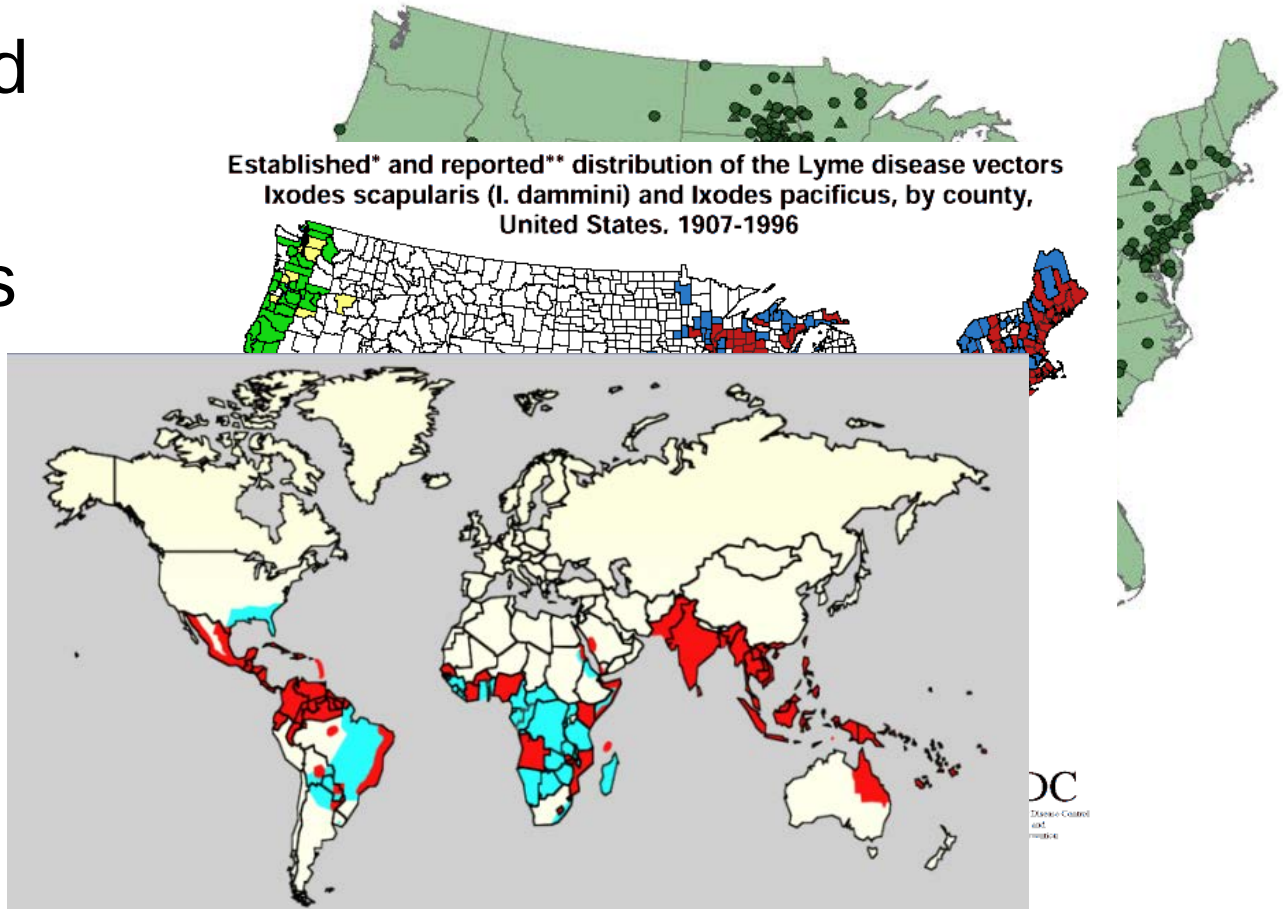


Source: Franklin County Emergency Management and Homeland Security

Climate change is bad for Ohio

Insect-transmitted disease

- West Nile Virus
- Lyme Disease
- Dengue Fever



Note 10. Confalonieri et al., 2007

Note 11. Maps

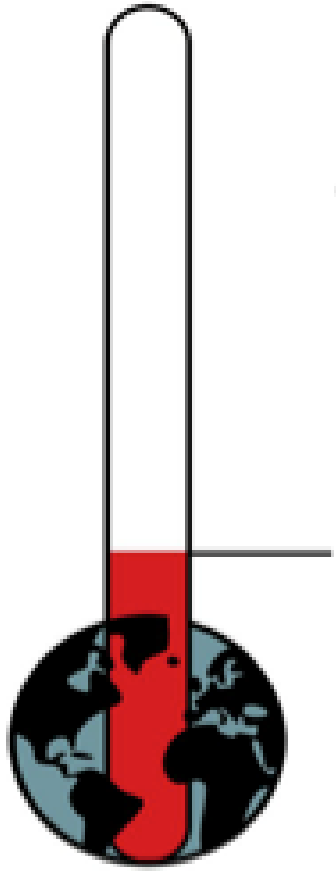
Climate change is bad for Ohio

Vulnerable populations most at risk:

- The poor, the very young and very old
- Those with mental and physical handicaps
- Those with chronic health conditions

Note 9.

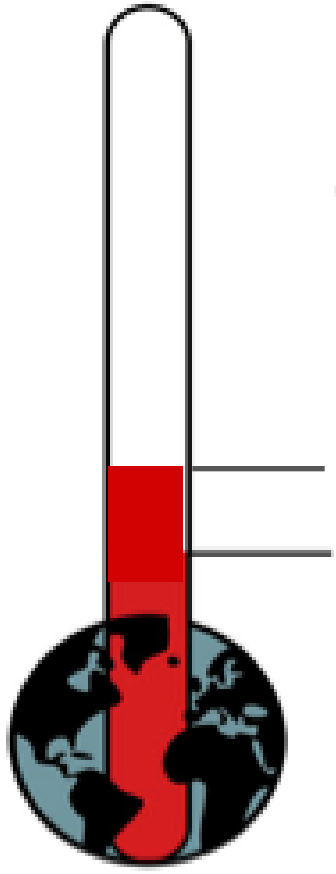
How high is too high?



1.5˚ – Observed warming since the pre-industrial age (about 1800)

Note 5. Hansen et al., 2010

How high is too high?

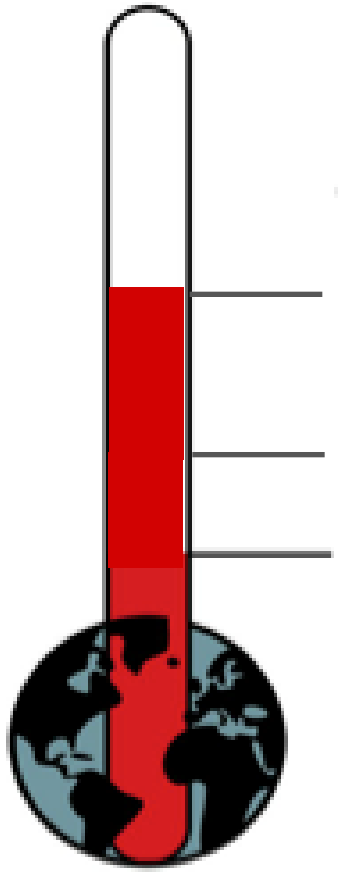


3.6˚ – The threshold of danger

1.5˚ – Observed warming since the pre-industrial age (about 1800)

Note 12. den Elzen and Meinshausen, 2005; Rogeli et al., 2009

How high is too high?



7.2˚ – 2100 Projection

3.6˚

1.5˚

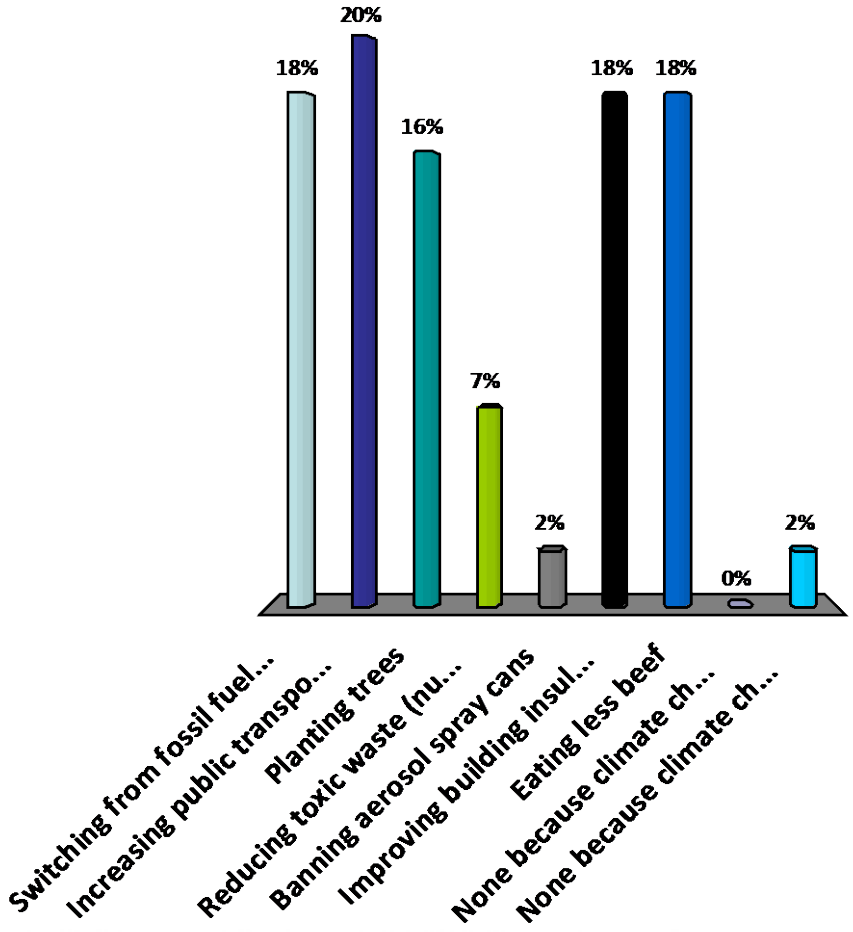
- Highest temps in 30 million years
- Sea level rise of 3-6 feet
- Drought on 40% of inhabited land
- Half of known species extinct

Note 13. Potsdam Institute for Climate Impact Research and Climate Analytics, 2012

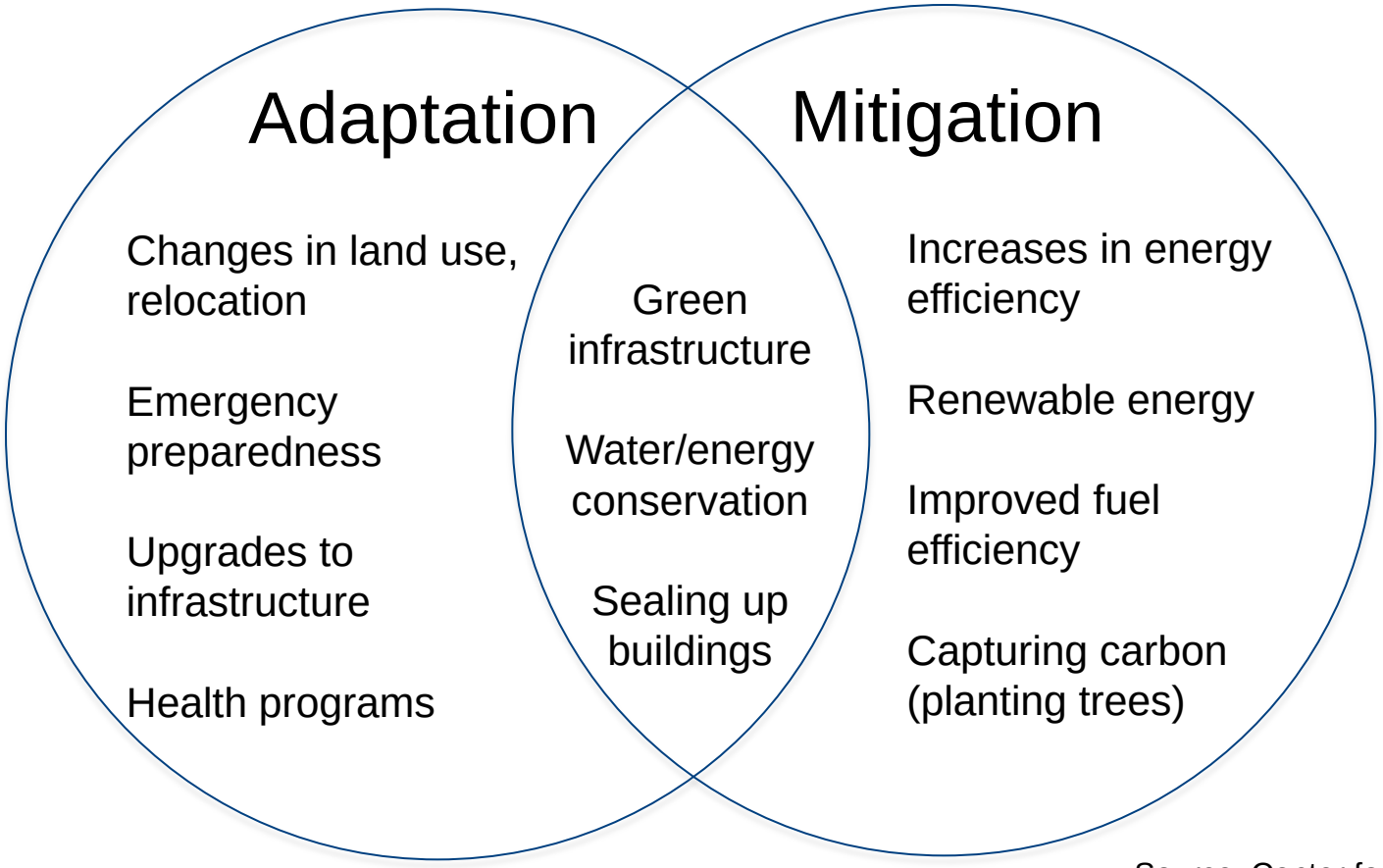
Can we do anything about it?

Which of the following actions do you think would reduce climate change? (Select all that apply)

1. Switching from fossil fuels to renewable energy
2. Increasing public transportation
3. Planting trees
4. Reducing toxic waste (nuclear, chemical)
5. Banning aerosol spray cans
6. Improving building insulation
7. Eating less beef
8. None because climate change is not influenced by humans
9. None because climate change is not happening



We can do something about it!



Source: Center for Clean Air Policy

“We” are doing something about it!

- Conversion of city vehicle fleet to alternative fuels
- Commitment to “green building” for city facilities
- Residential recycling and bike sharing programs
- Expansion of regional bikeway network
- Expanding the city’s tree canopy

- And more! – columbus.gov/GetGreen

You can do something about it!

Action	Carbon reduced (lbs/yr)*	Money saved ($$/yr)*
Around your house…		
- Turn down your heat 5˚ at night	1148	$107
- Keep your house 5˚ warmer in the summer	1646	$43
- Wash clothes with cold water (5 loads/wk)	425	$32
Around your garage…		
- Reduce miles by 10 per week	531	$85
- Do regular maintenance (e.g., tires inflated)	1784	$248
TOTALS	**5534**	**$515**

Source: US EPA Household Carbon Footprint Calculator

*Based on an average US family of 4 and 83,000 pounds of CO2 emissions per year

Takeaways for today

- Climate change is real
- Current climate change is caused by people
- Climate change is having (and will have) negative impacts on people in Columbus
- We can do (and are doing) something about it!

- Thank you!
  - For more information contact Richard Hicks
    - Email: rickh@columbus.gov, Phone: (614) 645-6189

Notes and References

1. "Greenhouse gases effectively absorb thermal infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus greenhouse gases trap heat within the surface-troposphere system. This is called the greenhouse effect. Thermal infrared radiation in the troposphere is strongly coupled to the temperature of the atmosphere at the altitude at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of, on average, –19° C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14° C. An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radiative forcing that leads to an enhancement of the greenhouse effect, the so-called enhanced greenhouse effect." **Annex II Glossary. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/publications_and_data/ar4/syr/en/annexessglossary-e-i.html , Retrieved 08 October 2013.**
2. "CO_2 concentrations measured from ice collected at Law Dome glacier in the Antarctic show that atmospheric CO2 has been remarkably constant at about 270 to 280 ppm over about the last 1000 years until the 18th century when it began to rise. As of 2005, the level had risen to 378 ppm, an increase of 35%. On the basis of ice core records the current CO2 concentrations are unprecedented for at least the last 650,000 years." **Scripps Institute of Oceanography CO2 Program. http://scrippsco2.ucsd.edu/faq/faq.html , retrieved 08 October 2013.**
3. Temperatures were about 9 degrees F cooler 20,000 years ago during the last glacial maximum. **Hansen, JE and Sato, M, Berger, A, Mesinger, F, and Sijacki, D, 2012. Paleoclimate implications for human-made climate change, Springer.**
4. Ice was several miles thick over what are now large North American cities. **Dyke, A, Andrews JT, Clark PU, England J, & Miller G, 2002. The Laurentide and Innuitian Ice Sheets During the Last Glacial Maximum, Quaternary Science Reviews, Vol. 21, pp. 9-31.**
5. Temperatures have increased 1.5 degrees F in past 250 years. **Hansen, J, Ruedy, R, Sato, M, and Lo, K, 2010: Global surface temperature change, Rev. Geophys. 48, RG4004.**
6. CO_2 is much higher than in the past 400,000 years or more. **i. Hansen, Climate Change, Vol. 68, 269, 2005. ii. Ogburn, Scientific American, May 10, 2013: http://www.scientificamerican.com/article.cfm?id=ice-free-arctic-in-pliocene-last-time-co2-levels-above-400ppm, accessed 10/09/2013.**
7. 97% of climate scientists agree that global warming is happening and that people have something to do with it. **i. WRL Anderegg, "Expert Credibility in Climate Change," Proceedings of the National Academy of Sciences Vol. 107 No. 27, 12107-12109 (21 June 2010); DOI: 10.1073/pnas.1003187107. ii. P. T. Doran & M. K. Zimmerman, "Examining the Scientific Consensus on Climate Change," Eos Transactions American Geophysical Union Vol. 90 Issue 3 (2009), 22; DOI: 10.1029/2009EO030002.** iii. **N. Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," Science Vol. 306 no. 5702, p. 1686 (3 December 2004); DOI: 10.1126/science.1103618.**

Notes and References, cont.

8. Sources of greenhouse gases include transportation, energy production, industry, and deforestation. **US EPA. http://www.epa.gov/climatechange/ghgemissions/sources.html, accessed 10/09/2013**

9. Heat-related deaths; increased frequency, duration and severity of heat waves; greater numbers of ticks and mosquitoes surviving in winter,increasing spread of West Nile Virus and Lyme Disease; more frequent and intense heat waves will increase likelihood of ozone formation. **USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J. M. Melillo, and T. C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.** Heat waves, heat stroke and dehydration; young children, older adults, people with medical conditions, and the poor are more vulnerable than others to heat-related impacts. **i. USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA. ii. CCSP (2008). Analyses of the effects of global change on human health and welfare and human systems . A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors). U.S. Environmental Protection Agency, Washington, DC, USA.** Impacts on air quality: as of 2008, 126 million Americans lived in counties that don't meet National Air Quality Standards. Warmer temperatures will increase the frequency of days with unhealthy levels of ground-level ozone and smog. **i. CCSP (2008). Analyses of the effects of global change on human health and welfare and human systems . A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors). U.S. Environmental Protection Agency, Washington, DC, USA. Ii. EPA (2010). Our Nation's Air: Status and Trends Through 2008 (PDF). U.S. Environmental Protection Agency. EPA -454/R -09-002.** Ground-level ozone is harmful to lung tissue, can reduce lung function and inflame airways, can increase respiratory symptoms and aggravate asthma. Especially harmful to children, older adults, outdoor workers and those with lung diseases. **NRC (2010). Adapting to the Impacts of Climate Change . National Research Council. The National Academies Press, Washington, DC, USA.** Climate change likely to increase levels of number of days with poor air quality…possible 68% increase in number of "unhealthy for everyone" air quality days in 50 largest U.S. cities by 2050. **USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.** Worsening air quality will lead to more fine particulates in the atmosphere, from power plants gas and diesel engines, fires, high-temperature industrial processes – inhaling can lead to premature mortality, aggravation of cardiovascular and respiratory diseases, development of chronic lung diseases, exacerbation of asthma, decreased lung function and growth in children. **EPA (2009). Integrated Science Assessment for Particulate Matter: Final Report . U.S. Environmental Protection Agency, Washington, DC, USA**

Notes and References, cont.

Changes in allergens….spring pollen season earlier in year as climate warms and season longer because of rising temperatures. Also facilitation of more ragweed. **i. USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA. ii. CCSP (2008). Analyses of the effects of global change on human health and welfare and human systems . A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors). U.S. Environmental Protection Agency, Washington, DC, USA. iii. Confalonieri, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich and A. Woodward (2007). Human health. In: Climate Change 2007: Impacts, Adaptation and Vulnerability . Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change iv. Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds.), Cambridge University Press, Cambridge, United Kingdom.** Heavy rainfall or flooding can increase water-borne parasites such as Cryptosporidium and Giardia that are sometimes found in drinking water. These parasites can cause gastrointestinal distress and in severe cases, death. **USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.**

10. The geographic range of ticks that carry Lyme disease is limited by temperature. As air temperatures rise, the range of these ticks is likely to continue to expand northward. Typical symptoms of Lyme disease include fever, headache, fatigue, and a characteristic skin rash. **i. Confalonieri, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich and A. Woodward (2007). Human health. In: Climate Change 2007: Impacts, Adaptation and Vulnerability . ii. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds.), Cambridge University Press, Cambridge, United Kingdom.** In 2002, a new strain of West Nile virus, which can cause serious, life-altering disease, emerged in the United States. Higher temperatures are favorable to the survival of this new strain. **USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.**

Notes and References, cont.

11. West Nile Map: http://commons.wikimedia.org/wiki/File:West_Nile_Virus_Map-United_States_2012.jpg; Lyme Disease Map: http://www.azlyme.org/diagnosis.htm; Dengue Map: http://en.wikipedia.org/wiki/Dengue_fever

12. Avoiding the worst effects of climate change means keeping overall warming below 3.6 degrees F (2 degrees C). **i. den Elzen M, Meinshausen M. (2005). Netherlands Env. Assessment Agency. Meeting the EU 2° C climate target: global and regional emission implications. ii. Rogelj, J.; Hare, B,; Nabel, J.; Macey, K.; Schaeffer, M.; Markmann, K.; Meinshausen, M. (2009). Halfway to Copenhagen, no way to 2° C. Nature Reports Climate Change.**

13. The world is on course for a projected 7.2 degrees F of warming by 2100, assuming business as usual. **Potsdam Institute for Climate Impact Research and Climate Analytics, http://www.climateanalytics.org/sites/default/files/attachments/publications/Turn%20down%20the%20heat%2011-16-12.pdf, accessed 10/09/2013.**

Appendix B: Online Survey (Baseline)

Introduction

Thank you for participating in our survey!

We are interested in your views, opinions, and perspectives. There are no wrong or right answers. Just so you are aware your participation in this survey is voluntary. If you decide to stop participating in the study there will be no penalty to you. Your decision on whether to participate or stop the survey will not affect your current or future relationship with The Ohio State University.

All information gathered for this study will be kept confidential and at no time will this information be connected with your name. Any reports of the findings will be summarized with all answers to a question combined together. We will work to make sure that no one sees your survey responses without approval. But, because we are using the Internet, there is a chance that someone could access your online responses without permission. In some cases, this information could be used to identify if you took the survey. However, your IP addresses will not be collected by the researchers to reduce the risk that other people can view the responses.

An Institutional Review Board responsible for human subject's research at The Ohio State University reviewed this research project. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251. If you have questions about the survey, please contact Mac Crawford at jcrawford@cph.osu.edu.

Climate Beliefs

To begin, how much had you thought about climate change before today?

- ◯ Not At All
- ◯ Rarely
- ◯ Occasionally
- ◯ Frequently

How well informed do you feel you are about climate change?

- ◯ Not at all informed
- ◯ A little informed
- ◯ Somewhat informed

- ◯ Well informed
- ◯ Very informed

When you are watching, reading, or listening to different news channels, shows, or websites, generally speaking, how much attention do you pay to news and opinions about the following topics?

	No attention at all	A little	A moderate amount	A great deal of attention
News about environmental issues or topics	◯	◯	◯	◯
News about local health issues or problems	◯	◯	◯	◯

In the last few months, how much have you heard or read in the news about each of the following issues?

	None at all	A little	A moderate amount	A great deal
Global climate change	◯	◯	◯	◯
Extreme weather events	◯	◯	◯	◯
Insect borne disease	◯	◯	◯	◯

The following set of questions have to do with the relevance of climate change for you personally. Please indicate to what extent you agree or disagree with the following statements.

	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree
The issue of climate change is personally unimportant to me	◯	◯	◯	◯	◯
This survey about climate change is personally relevant to me	◯	◯	◯	◯	◯
The risk of climate change is personally relevant to me	◯	◯	◯	◯	◯

The following set of questions have to do about your opinions on climate change. Please select one response for each of the following questions. There are no right or wrong answers so your first inclination probably best represents how you think about climate change.

Do you think that climate change is happening?

Yes	No	I am not sure
○	○	○

How sure are you of your response to whether or not climate change is happening?

- ○ Not at all sure
- ○ A little sure
- ○ Somewhat sure
- ○ Quite sure
- ○ Very sure

Assuming climate change is happening, do you think it is...?

- ○ Caused mostly by human activities
- ○ Caused mostly by natural changes in the environment
- ○ Caused by both human activities and natural changes
- ○ None of the above because it isn't happening

Which of the following statements come closest to your view?

- ○ Humans can reduce climate change, and we are going to do so successfully.
- ○ Humans could reduce climate change, but it's unclear at this point whether we will do what's needed.
- ○ Humans could reduce climate change, but people aren't willing to change their behavior so we're not going to change it.
- ○ Humans can't reduce climate change, even if it is happening.
- ○ Climate change isn't happening.

When, if at all, will humans begin to experience negative consequences of climate change?

- ○ Humans will not experience negative consequences
- ○ We are already experiencing negative consequences
- ○

We will begin to experience negative consequences in the next 5 years

- We will begin to experience negative consequences in the next 5 to 15 years
- We will begin to experience negative consequences in the next 15 to 50 years
- We will being to experience negative consequences in the next 50 to 100 years
- We will begin to experience negative consequences hundreds of years from now

Which of the following, if any, are or will be most at risk to the negative consequences of climate change?

- Negative consequences of climate change will not occur.
- Other countries will be most at risk
- Other states will be most at risk
- Other counties in Ohio will be most at risk
- Other communities in Columbus will be most at risk
- My community in Columbus will be most at risk

Which of the following groups of people, if any, are or will be most at risk to the negative consequences of climate change?

- No one is at risk
- People who are unlike me
- People who come from a similar background as me
- Myself and my family

How severe do you think the effects of climate change are/will be for you personally?

- Not at all severe
- Slightly severe
- Moderately severe
- Very severe
- Extremely severe

How vulnerable do you feel to the effects of climate change?

- ◯ Not at all vulnerable
- ◯ Slightly vulnerable
- ◯ Moderately vulnerable
- ◯ Very vulnerable
- ◯ Extremely vulnerable

Please indicate to what extent you agree or disagree with the following statements. Please remember there are no right or wrong answers, we are simply interested in your view.

	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree
Climate change will negatively impact human health and well being.	◯	◯	◯	◯	◯
I am worried about the health impacts of climate change.	◯	◯	◯	◯	◯
I have a responsibility to take action to slow climate change.	◯	◯	◯	◯	◯
People who are important to me would not expect me to take action on climate change.	◯	◯	◯	◯	◯
People who I spend most of my time with are likely to take action on climate change.	◯	◯	◯	◯	◯
My actions can help to slow down climate change.	◯	◯	◯	◯	◯
My actions can make me less vulnerable to the health impacts of climate change.	◯	◯	◯	◯	◯
The city's actions can help to slow down climate change.	◯	◯	◯	◯	◯
The city's actions can make Columbus less vulnerable to the health impacts of climate change.	◯	◯	◯	◯	◯

How much do you think climate change will harm the health of...

	Not at all	Only a little	A moderate amount	A great deal	Don't know
You personally.	◯	◯	◯	◯	◯
Your family.	◯	◯	◯	◯	◯
People in your community.	◯	◯	◯	◯	◯

People in the United States.	○	○	○	○	○
People in other modern, industrialized countries.	○	○	○	○	○
People in developing countries.	○	○	○	○	○
Future generations of people.	○	○	○	○	○
Plant and animal species.	○	○	○	○	○

There are many actions people can take to address climate change. Below is a list of some of these actions. Please indicate how likely or unlikely you are to undertake these actions within the next month. If you already do the action listed, please indicate this in the column marked "I already do this." If this action is not applicable to you please indicate this in the column marked "NA."

	Unlikely	Somewhat unlikely	Undecided	Somewhat Likely	Likely	I already do this	NA
Use cold water in place of hot or warm water for washing clothes	○	○	○	○	○	○	○
Eat meat less often opting for a vegetarian option	○	○	○	○	○	○	○
Contact my state representative about addressing climate change	○	○	○	○	○	○	○
Drive less often when public transportation, walking, biking, or other alternatives are available	○	○	○	○	○	○	○

Please let us know which of the following factors motivates or motivated you to engage in the previous behaviors. (Check all that apply).

- ☐ Saving money
- ☐ Personal health
- ☐ Environmental impacts
- ☐ Impacts on other people
- ☐ Doing what is socially acceptable
- ☐ Personal satisfaction (it is the right thing to do)
- ☐ Convenience
- ☐ Other (Please type in the reason)

Below are some statements about the various actions one could take to address climate change and their possible outcomes. Please indicate how likely or unlikely each of the following actions is to reduce human contributions to climate change by reducing carbon emissions.

	Unlikely	Somewhat unlikely	Undecided	Somewhat likely	Likely
Using cold water in place of hot or warm water when washing clothes reduces household energy use	○	○	○	○	○
Eating meat less often and choosing a vegetarian option improves food efficiency (eating crops directly instead of feeding them to livestock)	○	○	○	○	○
Contacting my state representative encourages political action to slow climate change.	○	○	○	○	○
Driving less often when alternative transportation is available reduces transportation based energy use	○	○	○	○	○

Completing the sentence below, please indicate what best describes your opinion. The circles indicate the degree to which taking action to address climate change is represented by the word on the left (e.g. "Extremely Unnecessary") versus the word on the right (e.g. "Extremely Necessary"), where the middle is neither word in the pair.

"Taking at least 1 action that you <u>do not already do</u> to slow climate change would be…"

	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	
Unnecessary	○	○	○	○	○	○	○	Necessary
Unfair	○	○	○	○	○	○	○	Fair
Harmful	○	○	○	○	○	○	○	Beneficial
Unpleasant	○	○	○	○	○	○	○	Pleasant
Worthless	○	○	○	○	○	○	○	Valuable

Below are a list of hazards that can pose a threat to urban areas. Please tell us how much risk you feel each of the following events currently poses to Columbus on the scale provided from "not a risk at all" to a "very significant risk".

	Not a risk at all	Slight risk	Moderate risk	Significant risk	Very significant risk
Tornados	○	○	○	○	○

Dam Failure	○	○	○	○	○
Flooding	○	○	○	○	○
WMD (weapons of mass destruction) Terrorist Incident	○	○	○	○	○
Cyber-Terrorism	○	○	○	○	○
Infectious Disease	○	○	○	○	○
Severe Winter Weather	○	○	○	○	○
Hazardous Materials Incident	○	○	○	○	○
Transportation Accident - Aircraft	○	○	○	○	○
Severe Summer Weather	○	○	○	○	○

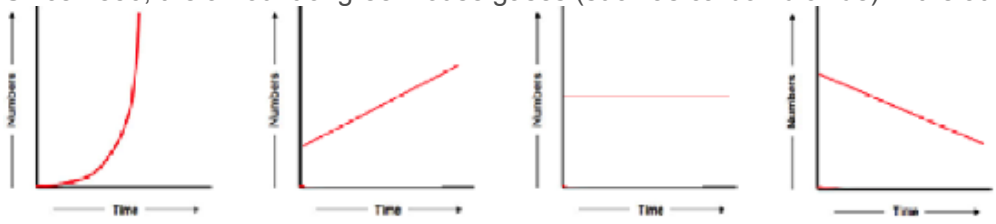
Knowledge

Please select the *one response* which, in your view, is the best answer to the following questions.

The Greenhouse Effect refers to:

- ○ Pollution that causes acid rain
- ○ The Earth's protective ozone layer
- ○ Gases in the atmosphere that trap heat
- ○ How plants grow
- ○ I am not sure

Since 1850, the amount of greenhouse gases (such as carbon dioxide) in the atmosphere have been...



Rapidly increasing	Gradually increasing	Staying the same	Gradually decreasing	I am not sure
○	○	○	○	○

Among the world's scientists...

- ◯ Most believe that climate change is happening.
- ◯ There is a lot of disagreement over whether or not climate change is happening.
- ◯ Most believe that climate change is not happening.
- ◯ I am not sure

Among the world's scientists...

- ◯ Most believe that climate change is caused by humans
- ◯ There is a lot of disagreement over whether or not climate change is caused by humans
- ◯ Most believe that climate change is not caused by humans
- ◯ I am not sure

Which of the following, if any, contribute to climate change? (Please select all of the responses that apply)

- ☐ Aerosol spray cans
- ☐ The hole in the ozone layer
- ☐ Burning fossil fuels to generate electricity
- ☐ Powering cars and trucks
- ☐ Cows and other livestock
- ☐ Deforestation
- ☐ Toxic waste
- ☐ Nuclear power plants
- ☐ None because climate change is not happening

Which of the following do you expect will be impacted in Ohio as a result of climate change? (Please select all that apply)

- ☐ Temperatures
- ☐ Amount of precipitation that falls in a year
- ☐ Amount of precipitation as snowfall

- [ ] Crop yields
- [ ] The frequency and intensity of extreme weather events
- [ ] Human health and safety
- [ ] None because climate change is not happening

Which, if any, of the following actions would reduce climate change? (Please select all that apply)

- [ ] Switching from fossil fuels to renewable sources of energy
- [ ] Increasing public transportation
- [ ] Planting trees
- [ ] Reducing toxic waste (nuclear, chemical)
- [ ] Banning aerosol spray cans
- [ ] Improving building insulation
- [ ] Eating less beef
- [ ] None because climate change is not influenced by humans
- [ ] None because climate change is not happening

Climate change will result in more of the following health problems... (Please select all that apply)

- [ ] Diabetes
- [ ] Cancer
- [ ] Asthma
- [ ] Tuberculosis
- [ ] Insect-borne disease (e.g., West Nile Virus)
- [ ] Heat stroke
- [ ] Storm-related injuries and deaths
- [ ] None because climate change is not happening

Policy Support

The following are strategies for addressing different aspects of climate change. Please indicate how much you would support or oppose these strategies being implemented in Columbus.

	Oppose	Somewhat oppose	Neither support nor oppose	Somewhat support	Support
Provide free or low-cost window screens to areas most vulnerable to West Nile and Dengue Fever.	○	○	○	○	○
Create energy efficient standards for residential rental properties and regulations requiring owners to meet those standards.	○	○	○	○	○
Create a "sustainability challenge" where small businesses and builders can compete to win tax breaks by being socially and environmentally responsible.	○	○	○	○	○
Develop a "vulnerability map" of areas where residents are at the highest risk of climate change-related impacts (such as extreme heat and flooding).	○	○	○	○	○
Allocate additional city resources to tracking climate change severity and addressing resulting health impacts.	○	○	○	○	○
Promote local food production to improve community self-reliance.	○	○	○	○	○

The following are strategies for addressing different aspects of climate change. Please indicate how much you would support or oppose these strategies being implemented in Columbus.

	Oppose	Somewhat oppose	Neither support nor oppose	Somewhat support	Support
Provide government incentives to homeowners to install alternative energy infrastructure (wind, solar, etc.) on new and existing homes.	○	○	○	○	○
Expand bike lanes and routes on city streets to increase bike commuting in the Columbus area.	○	○	○	○	○
Require smart meters on all houses and businesses to measure energy use for monitoring and billing purposes.	○	○	○	○	○
Offer low rent on city land for community gardening.	○	○	○	○	○
Plant more trees along city streets to provide shade and clean air.	○	○	○	○	○
Create cooling shelters in existing city facilities during extreme heat waves.	○	○	○	○	○

Mandatory spraying for mosquitos during high-risk periods.	○	○	○	○	○

Policy Near

Certain policies can be implemented either immediately or some time in the future. Please indicate your level of support for the following policies, remembering that they would be implemented immediately.

	Oppose	Somewhat oppose	Neither support nor oppose	Somewhat support	Support
Immediately begin building a light rail system linking neighborhoods, large retail areas, the airport, and downtown.	○	○	○	○	○
Immediately require home and business renovations over $25,000 to increase building energy efficiency by 10%.	○	○	○	○	○
Immediately begin requiring utility companies to produce more renewable energy each year.	○	○	○	○	○
Immediately provide a tax rebate to owners of highly fuel efficient vehicles.	○	○	○	○	○

Policy Far

Certain policies can be implemented either immediately or some time in the future. Please indicate your level of support for the following policies, remembering that they would be implemented in ten years.

	Oppose	Somewhat oppose	Neither support nor oppose	Somewhat support	Support
In ten years, begin building a light rail system linking neighborhoods, large retail areas, the airport, and downtown.	○	○	○	○	○
In ten years, being requiring home and business renovations over $25,000 to increase building energy efficiency by 10%.	○	○	○	○	○
In ten years, begin requiring utility companies to produce more renewable energy each year.	○	○	○	○	○

In ten years, begin providing a tax rebate to owners of highly fuel efficient vehicles.	○	○	○	○	○

Demographics

Now we want to know a bit more about you, as it will be very helpful in allowing comparisons between different groups of Columbus residents.

Are you?

Male ○ Female ○

What is your age? (in years)

Please specify your race. *(Mark one or more)*

- ☐ White
- ☐ Black, African American
- ☐ American Indian or Alaskan Native - *Type name of enrolled of principle tribe below*
- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Other Asian - *Type race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on below.*
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro

- [ ] Samoan
- [ ] Other Pacific Islander - *Type race, for example, Fijian, Tongan, and so on below.*
- [ ] Some other race - *Type race*

What is the highest level of education that you have completed?

- ◯ Less than high school
- ◯ High school graduate or GED
- ◯ Some College, business, or technical school
- ◯ Associate's degree
- ◯ Bachelor's degree
- ◯ Master's degree
- ◯ Professional degree
- ◯ Doctoral degree

What is your approximate annual household income from all sources before taxes?

- ◯ Less than $10,000
- ◯ $10,000 - $29,000
- ◯ $30,000 - $49,999
- ◯ $50,000 - $74,999
- ◯ $75,000 - $99,999
- ◯ $100,000 or more

Which of the following best describes your political orientation?

- ◯ Very liberal
- ◯ Liberal
- ◯ Moderate with liberal leanings
- ◯ Moderate with conservative leanings
- ◯

- Conservative
- Very conservative

Generally speaking, when it comes to political parties in the United States, how would you best describe yourself?

- Republican
- Independent (no leaning toward either party)
- Democrat
- Libertarian
- Other (Please describe in the box provided)

Please tell me how important each of these is as a guiding principle in YOUR life. We will use a 5-point scale, where the far left indicates that the statement is not at all important, and where the far right indicates that the statement is very important as a guiding principle for you.

	Not at all	A little important	Somewhat important	Quite important	Very important
Protecting the environment, preserving nature.	○	○	○	○	○
Fitting into nature, unity with nature.	○	○	○	○	○
Respecting the earth, harmony with other species.	○	○	○	○	○

Conlusion

Thank you for taking our survey! We appreciate your help in providing the City with some insight into public opinion about climate change in Columbus!

If you have any questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251. If you have questions about the survey, please contact Mac Crawford at jcrawford@cph.osu.edu.

Appendix C: Pre-Test and Post-Test Survey

Thank you for participating in our study, Insert study title here from IRB form!

We are interested in your views, opinions, and perspectives. There are no wrong or right answers. Just so you are aware your participation in this study is voluntary. If you decide to stop participating in the study there will be no penalty to you. Your decision on whether to participate or stop the study will not affect your current or future relationship with The Ohio State University.

All information gained in this study will be kept completely confidential and at no time will this information be connected with your name. Any reports of the findings will be summarized, with all answers combined together. We will work to make sure that no one sees your responses without approval.

An Institutional Review Board responsible for human subject's research at The Ohio State University reviewed this research project. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251. If you have questions about the survey, please contact Mac Crawford at jcrawford@cph.osu.edu.

I have read (or someone has read to me) this form and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name	**Signature**
	AM/PM
	Date and time
Printed name of person authorized to consent for subject (when applicable)	**Signature of person authorized to consent for subject (when applicable)**
	AM/PM
Relationship to the subject	**Date and time**

Clicker ID #_____

A. Please tell me how important each of these is as a guiding principle in YOUR life. We will use a 5-point scale, where 1 indicates that the statement is not at all important, and 5 indicates that the statement is very important as a guiding principle for you.

For the questions below, circle one response for each item.	Not at all Important	A little important	Somewhat important	Quite important	Very important
Protecting the environment, preserving nature.	1	2	3	4	5
Fitting into nature, unity with nature.	1	2	3	4	5
Respecting the earth, harmony with other species.	1	2	3	4	5

B. How much had you thought about climate change before today?

☐ **Not at all** ☐ **Rarely** ☐ **Occasionally** ☐ **Frequently**

C. How well-informed do you feel you are about climate change?

☐ **Not at all informed** ☐ **A little informed** ☐ **Somewhat informed** ☐ **Well informed** ☐ **Very informed**

D. Please indicate to what extent you agree or disagree with the following statement.

For the questions below, circle one response for each item.	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
The issue of climate change is personally unimportant to me.	-2	-1	0	1	2

E. Do you think that climate change is happening? ☐ Yes ☐ No ☐ I am not sure

For the questions below, circle one response for each item.	Not at all	A little	Somewhat	Quite	Very
How sure are you of your response to **question E** above? *(skip this question if you answered "I am not sure" above)*	1	2	3	4	5

F. Assuming climate change is happening, do you think it is… *(Please select one answer).*

- ❑ Caused mostly by human activities
- ❑ Caused mostly by natural changes in the environment
- ❑ Caused by both human activities and natural changes
- ❑ None of the above because it isn't happening

G. Which of the following statements come closest to your view? *(Please select one answer).*

- ❑ Humans can reduce climate change, and we are going to do so successfully.
- ❑ Humans could reduce climate change, but it's unclear at this point whether we will do what's needed.
- ❑ Humans could reduce climate change, but people aren't willing to change their behavior so we're not going to change it.
- ❑ Human can't reduce climate change, even if it is happening.
- ❑ Climate change isn't happening.

Please stop here, and fill out the remaining pages once the presentation has completed. Our final questions assume you have seen the presentation, so waiting until the end is very important.

Thank you.

Clicker ID #_____

A. How well-informed do you feel you are about climate change?

☐ **Not at all informed** ☐ **A little informed** ☐ **Somewhat informed** ☐ **Well informed** ☐ **Very informed**

B. For the following statements, please indicate how strongly you disagree or agree by circling the response that best represents your opinion. There are no right or wrong answers, we are simply interested in your view.

For the questions below, circle one response for each item.	**Disagree**	**Strongly disagree**	**Neither agree nor disagree**	**Somewhat agree**	**Agree**
I am worried about the health impacts of climate change.	-2	-1	0	1	2
I have a responsibility to take action to slow climate change.	-2	-1	0	1	2
My actions can help to slow down climate change.	-2	-1	0	1	2
My actions can make me less vulnerable to the health impacts of climate change.	-2	-1	0	1	2
The city's actions can help to slow down climate change.	-2	-1	0	1	2
The city's actions can make Columbus less vulnerable to the health impacts of climate change.	-2	-1	0	1	2

C. How much do you think climate change will harm the health of…

For the questions below, circle one response for each item.	**Not at all**	**Only a little**	**A moderate amount**	**A great deal**	**I am unsure**
You personally.	1	2	3	4	0
Your family.	1	2	3	4	0
People in your community.	1	2	3	4	0
People in the United States.	1	2	3	4	0
People in other modern, industrialized countries.	1	2	3	4	0
People in developing countries.	1	2	3	4	0
Future generations of people.	1	2	3	4	0
Plant and animal species.	1	2	3	4	0

D. Climate change will result in more of the following health problems (select all that apply):

- ❑ Diabetes
- ❑ Cancer
- ❑ Asthma
- ❑ Tuberculosis
- ❑ Insect-borne disease (e.g., West Nile Virus)
- ❑ Heat stroke
- ❑ Storm-related injuries and deaths
- ❑ None because climate change is not happening

E. There are many actions people can take to address climate change. Below is a list of some of these actions. Please indicate how likely or unlikely you are to undertake these actions within the next month. If you already do the action listed, please circle "4" in the column marked "I already do this." If you feel an action is not applicable to you, circle "5" under the column marked "NA."

For the questions below, circle one response for each item.	Unlikely	Somewhat unlikely	Undecided	Somewhat likely	Likely	I already do this	NA
Use cold water in place of hot or warm water for washing clothes.	-2	-1	0	1	2	3	4
Eat meat less often opting for vegetarian.	-2	-1	0	1	2	3	4
Contact my state representative about addressing climate change.	-2	-1	0	1	2	3	4
Drive less often when public transportation, walking, biking or other alternatives are available.	-2	-1	0	1	2	3	4

F. Below are some statements about the various actions one could take and their possible outcomes. Please indicate how likely or unlikely each of the following actions is to reduce a person's contribution to climate change through reducing carbon emissions.

For the questions below, circle one response for each item.	Unlikely	Somewhat Unlikely	Neither unlikely nor likely	Somewhat likely	LIkely
Using cold water in place of hot or warm water when washing clothes reduces household energy use.	-2	-1	0	1	2
Eating meat less often and choosing a vegetarian option improves food efficiency (eating crops directly instead of feeding them to livestock).	-2	-1	0	1	2
Contacting my state representative encourages political action to slow climate change.	-2	-1	0	1	2
Driving less often when alternative transportation is available reduces transportation based energy use.	-2	-1	0	1	2

G. Below are some possible strategies for addressing climate change in Columbus. We are interested in the extent to which you support or oppose the following options.

For the questions below, circle one response for each item.	Oppose	Somewhat oppose	Neither support nor oppose	Somewhat support	Support
Create cooling shelters in existing city facilities during extreme heat waves.	-2	-1	0	1	2
Mandatory spraying for mosquitos during high-risk periods	-2	-1	0	1	2
Provide free or low-cost window screens to areas most vulnerable to West Nile and Dengue fever	-2	-1	0	1	2
Allocate additional city resources to tracking climate change severity and addressing resulting health impacts.	-2	-1	0	1	2
Develop a "vulnerability map" of areas where residents are at the highest risk of climate change-related impacts (such as extreme heat and flooding).	-2	-1	0	1	2

The following demographic information will be used to help make general conclusions about the group of people being surveyed. <u>Your responses will remain completely confidential</u>.

A. Are you…? __ Male __ Female

B. What is your age? _____ Years

C. Do you consider yourself to be Hispanic or Latino? ☐ Yes ☐ No

D. Please specify your race. *(Mark one or more boxes)*

- ☐ White
- ☐ Black, African American
- ☐ American Indian or Alaska Native – *Print name of enrolled or principle tribe below*

  _____

- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Other Asian – *Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on below.*

  _____

- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese

- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander – *Print race, for example, Fijian, Tongan, and so on below*

  _____

- ☐ Some other race – *Print race*

  _____

E. What is the highest level of education that you have completed?

- ❑ Less than high school
- ❑ High school graduate or GED
- ❑ Some College, business, or technical school
- ❑ Associate's degree
- ❑ Bachelor's degree
- ❑ Master's degree
- ❑ Professional degree
- ❑ Doctoral degree

F. What is your approximate annual household income from all sources before taxes?

- ❑ Less than $10,000
- ❑ $10,000 – $29,999
- ❑ $30,000 - $49,999
- ❑ $50,000 - $74,999
- ❑ $75,000 - $99,999
- ❑ $100,000 or more

G. Which of the following best describes your political orientation?

- ❑ Very liberal
- ❑ Liberal
- ❑ Moderate with liberal leanings
- ❑ Moderate with conservative leanings
- ❑ Very Conservative
- ❑ Conservative

H. Generally speaking, when it comes to political parties in the United States, how would you best describe yourself?

- ❑ Republican
- ❑ Independent (no leaning toward either party)
- ❑ Democrat
- ❑ Libertarian
- ❑ Other_____

I. When thinking of the presenter you just heard speak about climate change, please circle the number between the pair of words that best describes your feelings about the information you received from them, where -2 equals strong agreement with the phrase on the left and where 2 equals strong agreement with the phrase on the right, and 0 equals indifference or no opinion.

Can't be trusted	-2	-1	0	1	2	*Can be trusted*
Is inaccurate	-2	-1	0	1	2	*Is accurate*
Is unfair	-2	-1	0	1	2	*Is fair*
Is biased	-2	-1	0	1	2	*Is unbiased*

J. When you are watching, reading, or listening to different news channels, shows, or websites, generally speaking, how much attention do you pay to news and opinions about the following topics?

For the questions below, circle one response for each item.	No attention at all	A little attention	A moderate amount of attention	A great deal of attention
News about environmental issues or topics	0	1	2	3
News about local health issues or problems	0	1	2	3

K. In the last few months, how much have you heard or read in the news about each of the following issues?

For the questions below, circle one response for each item.	None at all	A little	A moderate amount	A great deal
Global climate change	0	1	2	3
Extreme weather events	0	1	2	3
Insect-borne disease	0	1	2	3

L. Would you be interested in participating in future research related to climate change in Columbus?

❑ No

❑ Yes

If yes, please write your email address on the line provided so that we can contact you in the future. If you do not have an email address, please write your mailing address.

_____ _____

****

Please tear off and keep this last section, in case you have any further questions about this study.

Thank you for taking the time to participate! Your responses will be used to help inform efforts to effectively deal with climate change in Columbus. **For more information**, please contact Mac Crawford at:

Phone: 614-263-7491

Email: jcrawford@cph.osu.edu

An Institutional Review Board responsible for human subject's research at The Ohio State University reviewed this research project. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.